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A Change of Course

The Importance to DoD of International Standards for Electronic Commerce

Judith E. Payne

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A Change of Course

The Importance to DoD of International Standards for Electronic Commerce

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Judith E. Payne
with Robert H. Anderson

Prepared for the
Assistant Secretary of Defense
(Production and Logistics)



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PREFACE

The U.S. Department of Defense (DoD) is committed to using electronic commerce in the future with the over 300,000 vendors interested in doing business with DoD. Electronic commerce will move DoD from a paper-based world to one based on electronic transactions enabled by the exchange of formatted, electronic messages referred to as electronic data interchange (EDI). With electronic commerce, DoD plans to reduce costs, increase effectiveness, and make it easier for vendors to deal with DoD.

Benefits from electronic commerce are enhanced when many businesses use the same standards for EDI messages themselves and their transmission. The fewer standards used, the less time and resources must be spent translating messages and agreeing on how to use different standards. To enhance benefits and smooth the transition to electronic commerce for itself and its vendors, DoD has chosen to use the widely accepted American National Standards Institute (ANSI) X12 standards for EDI messages, coupled with international standards for delivering messages and organizing addresses. In the past 18 months, EDI standards sponsored by a United Nations body and serving the same purpose as ANSI X12 message standards have begun to gain wider acceptance internationally.

This report presents results of a study examining the implications to DoD of the domestic and international standards under development to enable electronic commerce. It presents recommendations regarding the use of standards by DoD and its role in standards development.

The study results will be useful to senior policymakers directing DoD's EDI efforts, as well as to those involved in setting EDI standards in the United States and elsewhere. Readers may also find of interest a closely related RAND report, Judith E. Payne and Robert H. Anderson, *Electronic Data Interchange (EDI): Using Electronic Commerce to Enhance Defense Logistics*, R-4030-P&L, 1991.

This project was carried out within the Applied Science and Technology Program of RAND's National Defense Research Institute, a federally funded research and development center sponsored by the Office of the Secretary of Defense and the Joint Staff. The study was sponsored by the Assistant Secretary of Defense (Production and Logistics).

SUMMARY

OVERVIEW

The U.S. Department of Defense (DoD) is now implementing electronic commerce, the use of electronic documents, rather than hard-copy forms, for business transactions. Conducting business in this way requires standard formats that are acceptable both to DoD's vendors and to the hundreds of DoD sites involved. It has chosen the most commonly used standard for such transactions today: the American National Standards Institute's (ANSI's) X12 standard.

Another standard serving the same purpose is being developed internationally through the United Nations (UN): EDIFACT. In the past two years, EDIFACT's international acceptance has grown dramatically, and it has just been designated as an acceptable standard along with ANSI X12 for Federal government electronic data interchange (EDI) users. Further, U.S. industry is becoming increasingly international, so interest in EDIFACT standards is growing within the United States. The research we conducted addresses the implications of these changes for DoD's choice of EDI standards. It also considers DoD's plans to use other international standards needed to implement electronic commerce.

Our research has led us to recommend that DoD continue to implement electronic commerce using X12 as the default EDI message standard, but do nothing to preclude the use of EDIFACT standards by its vendors. DoD should include EDIFACT messages in its implementation guides for DoD users and use EDIFACT standards when its vendors prefer them to X12. DoD should participate more actively in the X12 and EDIFACT processes and support efforts to bring about and maintain alignment. Finally, we recommend that DoD continue its plans to use the international standards needed to complement message standards.

INTRODUCTION

Electronic commerce, an important new way of doing business, is enabled by EDI. Thousands of U.S. firms are beginning to use it to exchange transactions in electronic formats so that business flows more quickly and efficiently, often without human intervention. DoD is committed to electronic commerce. It formally recognized EDI as a DoD-wide management initiative and launched a project to put the

needed infrastructure in place. Dozens of EDI pilot projects are now under way.

To facilitate the introduction of EDI for itself and the over 300,000 vendors interested in conducting business with DoD, DoD plans to use three complementary standards for EDI. Two, X.400 and X.500, are from the Consultative Committee for International Telegraph and Telephone (CCITT). They cover message handling (i.e., how EDI transactions can be addressed and moved across electronic networks between senders and receivers) and electronic address directories, respectively. The third, the ANSI X12 standard for EDI messages themselves, is by far the most commonly used nonproprietary message standard in the United States.

Although EDI users universally agree that the two CCITT standards both need improvement and more widespread use, no competing, nonproprietary standards are being developed. In contrast, an international standard is being developed in parallel with X12: the United Nations EDIFACT standard.

In 1988, when DoD mandated the use of the X12 message standard, it was the obvious choice; there were far more X12 messages than EDIFACT messages approved for use and few EDIFACT users in the United States. These facts still stand, but, since then, two factors have increased the importance of EDIFACT to U.S. industry and government. First, the EDIFACT process has gained wider international acceptance. Second, a new Federal Information Processing Standard (FIPS) allows federal agencies to use *either* X12 *or* EDIFACT. Although DoD can, of course, choose a more narrow mandate than the FIPS, these changes suggest that DoD's current position regarding EDI standards may need to be reassessed.

This study set out to evaluate the implications of these factors to DoD's effort to move toward electronic commerce and to recommend whether DoD should change its support of EDI standards. Interviews were conducted with DoD officials involved with EDI, government and industry participants in the ANSI X12 process, and participants in EDIFACT and other international standards processes. Existing data on international trade were analyzed, and pertinent literature and government documents were reviewed.

INTERNATIONAL EDI STANDARDS ARE IMPORTANT TO DoD

International EDI standards are important to DoD because international commerce is important to DoD. Although DoD itself does not conduct a large share of its business internationally, the supply chains and customer bases of U.S. industry are becoming increasingly international. Even disregarding oil imports and agricultural exports, U.S. foreign trade increased 92 percent between 1983 and 1989. If DoD's industrial base is to remain competitive and financially sound, this globalization must continue.

As DoD's suppliers become more international and as they adopt EDI, they will probably want EDI standards that they can use with as many trading partners as possible. Using fewer standards reduces both the cost of EDI and the risk of business errors. If international EDI message standards are useful, if they are actually used both domestically and abroad, and if the suppliers can influence their development, these firms—DoD's industrial base—will tend to use them.

Some would argue that choosing one message standard is unnecessary, because an EDI user can simply translate between standards. Most businesses using EDI already translate EDI messages to and from the electronic formats of their internal application software. So, the argument goes, it does not matter what standards are used. In reality, the problem is much more difficult. Even using the same message standard, trading partners must reach detailed agreement regarding exactly how the standard will actually be used. To address these challenges, groups of EDI trading partners, entire industries, and DoD are developing implementation guides for each separate X12 message. Adding another (and growing) set of standards to this process increases its complexity dramatically. Further, each standard a firm uses requires internal support and, ideally, participation in the standard development process. Even now, these are not trivial tasks; they contribute to the difficulty many firms face in expanding their use of EDI. These problems will grow even larger as EDI messages are developed for more complex and time-sensitive business functions. Thus, translation software is not a reasonable long-term bridge between EDI message standards.

Given DoD's objectives for using EDI, it must pay attention to the standards of interest to U.S. businesses, whether these standards are developed internationally or domestically. As U.S. firms become more interested in international EDI standards, DoD must as well. Indeed,

DoD may need to help U.S. firms understand the importance of world-wide standards to support open EDI.

THE INTERNATIONAL COMMUNITY IS COMMITTED TO EDIFACT

Although EDIFACT is not yet as fully developed as X12, it is the only message standard with broad endorsement worldwide. Since mid-1989, the international community's commitment to EDIFACT has grown dramatically. The 12 European Economic Community (EEC) governments, accounting for 39 percent of world trade flows in 1989, have mandated the use of EDIFACT. The six European Free Trade Association countries have also done so. EEC countries also plan to use EDIFACT to ease their transition to fewer trade barriers in 1993. Commitments to EDIFACT are growing outside of Europe as well. Two new regional EDIFACT boards, for Australia and New Zealand and for Japan and Singapore, were set up in 1990. They join the three other boards for North America, western Europe, and eastern Europe. Several industry and government groups are prime players in EDIFACT, including the Customs Cooperation Council.

The international community's endorsement of EDIFACT is not surprising; the standard is a result of an international process in the mid-1980s. What is not well known in the United States is that ANSI X12 representatives were key players in this effort; EDIFACT was a compromise between ANSI X12 and existing European standards. The EDIFACT syntax and data directories were then adopted by the International Standards Organization (ISO), a nongovernmental standards body, of which ANSI is the U.S. member.

U.S. FIRMS SHOW LITTLE INTEREST IN EDIFACT TO DATE

To date, few U.S. firms use or show interest in EDIFACT. This is not surprising. Many U.S. EDI users have not yet adopted any nonproprietary standards; most are not far along in their introduction of EDI and begin with domestic partners; and X12 currently offers many more finalized messages developed specifically for U.S. users.

Nonetheless, the United States has been an important player in the EDIFACT process. The North American EDIFACT board was one of the first to be created. In a 1990 poll of Accredited Standards Committee members, 97 percent of respondents (14 percent response rate)

were in favor of aligning the two standards by 1993 or earlier. The EDIFACT board message development work in the United States is conducted within ANSI X12 working groups. In 1989, the chair of X12 wrote an open letter to its members to reaffirm the group's commitment to the development of EDIFACT as a worldwide standard. The X12 steering committee then created a working group to develop a plan to achieve alignment of X12 and EDIFACT.

It is not yet clear how well or fast this group will be able to work toward alignment. Many X12 members, unaware that EDIFACT is already the result of a compromise process involving X12, see alignment as a convergence process and are wary of "capitulating" to European-dominated standards. There is also great concern about the costs to users of any changes in the X12 standards that do not build on U.S. experience with EDI.

INTERNATIONAL STANDARDS COMMUNITY SHARES U.S. CONCERNS

Although their concerns are rational, U.S. EDI users should not worry that the EDIFACT process will ignore their experience and problems with EDI standards; those elsewhere share many of these concerns. Despite the growing international commitment to EDIFACT, few are satisfied with it today. There are many suggestions to improve both the standard and the standard-setting process. Many are concerned that messages from both processes are designed to mimic the paper documents they replace, rather than taking full advantage of their electronic form to change business practices. Another serious concern is that neither standard addresses broader business needs beyond trade. Structured electronic messages are not yet available for the entire business cycle of product design, manufacture, distribution, sales, and product support. This calls for a broader definition of EDI and the inclusion of digitized product data within or linked to EDI messages. DoD's Computer-Aided Acquisition and Logistics Support (CALS) program, which already involves hundreds of U.S. firms, is recognized worldwide as a promising effort to address this concern.

Those interested in EDI are also concerned that a version of the X.400 standard be developed for EDI messages specifically and that X.500 directories be implemented and easily accessible. X.400 is now being considered by the CCITT membership. Comparable progress has not yet been made on X.500. Finally, EDI standard developers also share

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DoD's concern that electronic commerce enabled by EDI be easily accessible by small businesses. There is interest outside the U.S. in DoD's efforts to build the electronic infrastructure to achieve this objective.

RECOMMENDATIONS: DoD'S USE OF EDI STANDARDS

Given these findings, we recommend that DoD broaden its support of EDI message standards to include finalized EDIFACT messages as well as X12. Because X12 is the most widely used message standard in the United States, DoD should continue to concentrate its electronic commerce implementation efforts on X12 messages. But it should do nothing to preclude the use of EDIFACT message standards by DoD vendors and should support the development and improvement of these standards to meet DoD and vendor needs. This change of course means that, at a vendor's option, DoD should exchange any EDIFACT messages comparable to the X12 messages it uses and include such messages in its EDI implementation guides.

DoD should continue its plans to use X.400 and X.500 as critical parts of its electronic commerce infrastructure, but not require their use by trading partners until their structure for EDI purposes is better defined and well tested.

RECOMMENDATIONS: DoD AND THE EDI MESSAGE STANDARDS PROCESSES

The EDIFACT standards are not static, but it is not yet clear how they will change in the next few years. DoD is only one player in the standards processes, but one with great influence. Now is a critical time for it to use its position to address users' concerns and to facilitate open EDI worldwide for large and small businesses. To do so, DoD should participate in the X12 and EDIFACT standards processes with two objectives: (1) to bring the current standards into alignment and (2) to change the processes so that the standards remain aligned. DoD is already an important player in X12; it should become one in EDIFACT as well by serving on the North American EDIFACT Board and having representatives of its electronic commerce initiatives on the U.S. delegation to the UN working party that oversees the EDIFACT boards.

Having aligned standards does not mean having a single set of message standards worldwide. That is practically impossible for the

foreseeable future and not necessary to facilitate international electronic commerce. Rather, it means that message standards should share a common syntax, data element and coding directories, and usage conventions. Actual message content might vary between sets of standards, as might the number and types of messages. This approach is consistent with current X12 alignment work. DoD should help strengthen the X12 membership's support and understanding of this work and the resources applied to it. To the extent its resources allow, DoD should directly participate in the alignment effort.

Alignment efforts and changes to the standards processes should not be seen from a nationalistic perspective with comparable changes required on the U.S. and non-U.S. "sides." No one should "keep score." The criteria for success should be a set of standards that are compatible (i.e., aligned), are flexible for users, take full advantage of available technology, and meet business needs. They should also address the user concerns mentioned above. In this light, DoD should consider ways to open all or part of its CALS process to the international community.

The worldwide standards process could take several forms as long as it allows participation by all interested EDI users, individual firms or industry groups; follows reasonable protocols for considering user input; offers stability with a controlled but reasonably efficient process to change standards in response to user needs; identifies various versions of standards in use; and provides accurate documentation of the common standard building blocks.

It is not within the scope of this report to specifically recommend the role of ANSI in this standards future. Generally, DoD should help shape its role to support the maintenance of aligned standards and, at the same time, serve U.S. EDI business needs where they differ from non-U.S. needs or are not yet met by worldwide message standards.

DoD should also support and help coordinate U.S. and non-U.S. efforts to improve and use X.400 to facilitate EDI and the widespread use of X.500 with improvements where usage demonstrates needs.

RECOMMENDED MILESTONES AND MONITORING PROCESS

The longer the EDIFACT and X12 message standards processes move forward in parallel, the higher the costs to users. Therefore, DoD should help accomplish alignment and requisite changes in the

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1. INTRODUCTION

Electronic commerce, an important new way of doing business, is enabled by electronic data interchange (EDI). Thousands of U.S. firms are beginning to use it to exchange transactions in electronic formats so that business flows more quickly and efficiently, often without human intervention. EDI enables these tighter links between buyers and sellers, distribution, and production; dramatic reductions in inventory; more flexible responses to uncertain demands; more flexible and timely product support; and more.

The U.S. Department of Defense (DoD) is committed to electronic commerce to conduct business. It is already a leader in innovative uses of EDI, with dozens of pilot projects under way. In 1988, DoD mandated that EDI be the way of doing business in the future. By 1990, EDI was recognized as a DoD-wide management initiative,¹ and the Electronic Commerce/EDI project was launched to put the infrastructure in place and to demonstrate how electronic commerce could be well used by all Defense components² in procurement, transportation, finance, and contract administration.

To facilitate the introduction of EDI *and* to make it most convenient for the over 300,000 vendors interested in conducting business with DoD,³ DoD mandated the use of one standard for EDI. Following the lead of U.S. industry, it chose the American National Standards Institute (ANSI)⁴ standard for EDI transactions (or "messages"), called X12, by far the most commonly used in the United States. Where X12 is not yet used within a particular industry, DoD components are permitted to use accepted industry standards until they migrate to X12.

The ANSI X12 standard development process is well established, with hundreds of businesses voluntarily participating, as well as DoD. This development is being conducted through the ANSI Accredited

¹Department of Defense, 1990.

²"Defense components" refers to Defense Services and other DoD agencies, such as the Defense Logistics Agency.

³No exact count is available of the number of vendors that conduct business with DoD. In FY89, 335,000 firms had Contractor and Government Entity codes in a DoD database, meaning they have done or have confirmed their interest in doing business with DoD within the last three years. Entries in this file are confirmed on a rotating, three-year basis.

⁴For brief descriptions of this organization and others mentioned later, see the Glossary.

Standards Committee (ASC) X12. Various industry standards are merging with X12,⁶ demonstrating the growing acceptance of X12 in the United States.

EDI transaction standards are not the only standards necessary for electronic commerce. DoD plans to use three other electronic standards to implement EDI, all from international standard-setting bodies. No nonproprietary U.S. standards are being developed that parallel these three standards. However, in parallel with ANSI X12 standards development, a United Nations (UN) standard for EDI, EDI for Administration, Commerce and Transport (EDIFACT), has also been under development. Far more X12 messages have been approved for use, and X12 has far more users in the United States, but, especially in the past 18 months, two factors have increased the importance of EDIFACT to U.S. industry and government. First, the EDIFACT process has gained wider international acceptance. Second, a new Federal Information Processing Standard (FIPS) allows federal agencies to use either X12 or EDIFACT standards for EDI, not only X12, as the DoD directive requires.⁶

The objective of the study summarized in this report was to evaluate the implications of these factors for DoD's effort to move toward electronic commerce. The research focused on three questions:

1. What may be the future Defense requirements for using EDI internationally?
2. How may these requirements be affected by various international standards related to EDI, including EDIFACT, Open System Interconnection (OSI), X.400, and X.500,⁷ as well as the FIPS endorsement of ANSI X12 or EDIFACT standards?
3. What would be a recommended strategy and transition plan for DoD regarding the use of EDI standards and standard-setting activities?

To answer these questions, dozens of interviews were conducted with those in DoD involved with EDI, government and industry participants in the ANSI X12 processes, and participants in EDIFACT and other international standards processes in the United States and in Europe. Existing data on international trade were analyzed, and

⁶For example, standards developed for the grocery (Uniform Communication Standard) and transportation industries (Transportation Data Coordinating Committee standard).

⁶National Institute of Standards and Technology, 1991.

⁷These standards are described in Sec. 2.

pertinent literature and government documents were reviewed, including two surveys of EDI users in the United States regarding EDI message standards.

TECHNICAL DIFFERENCES BETWEEN ANSI X12 AND EDIFACT STANDARDS

Others have analyzed in detail the technical differences between ANSI X12 and EDIFACT standards,⁸ and App. A describes the basic components of both message standards and how their terminology differs. For the purposes of this report, the reader need only know that they differ in both syntax and data elements, i.e., both in their structure and how units of information are defined. For example, X12 messages can contain a greater diversity of characters than EDIFACT messages. EDIFACT uses two more control characters (i.e., characters used to separate parts of a message) than X12 and provides default values where X12 does not. X12 defines six types of data elements, while EDIFACT defines three. Further, X12 messages do not use an equivalent to the EDIFACT composite data element, in which multiple values are within one element. Because these standards are being developed separately, they have different definitions for data elements in their directories, and the coding used to define different values for a particular element differs. The implications of these and other differences between the standards are discussed further in Sec. 2.

ORGANIZATION OF THIS REPORT

The study findings and recommendations are discussed in the following sections of the report. Section 2 describes why international standards for EDI are important to DoD. In Sec. 3, the international community's commitment to EDIFACT is chronicled, as are EDIFACT's origins. The use of EDI standards in the United States is assessed in Sec. 4 along with the efforts in the United States to align X12 and EDIFACT standards. The major concerns of the United States and international EDI standards communities are highlighted in Sec. 5. In Sec. 6, recommendations are presented regarding the use of standards by DoD, how they may be improved to facilitate electronic commerce, and DoD's role in the standard setting process.

⁸American National Standards Institute (ANSI), 1989 (also available in App. C of INPUT, 1989) or Trafford, 1989.

Appendix A describes the basic structure of EDI message standards. Appendix B lists the status of EDIFACT messages as of October 1990 and App. C presents a comparison of X12 and EDIFACT messages. In App. D, interviewees are listed, and in App. E, participants and observers of the EDIFACT standards process. A glossary follows the bibliography.

2. THE IMPORTANCE OF INTERNATIONAL EDI STANDARDS TO DoD

DoD would not have to pay attention to international EDI standards if international commerce were not important to DoD and if international *EDI standards* to support this commerce were not important. Below, we describe why international EDI standards *are* important to DoD.

The section closes with a discussion of three international standards that DoD is already committed to using to facilitate electronic commerce.

DoD'S INTERNATIONAL BUSINESS

Only a small fraction of DoD business is international. So, at first glimpse, international commerce appears irrelevant to DoD. Only 5 percent¹ of its contract actions in fiscal year 1989 were for work done outside the United States or with foreign firms for work done in the United States. Although a small fraction of total procurement actions and awards, this work still accounted for 732,000 procurement actions and awards of \$6 billion—enough business alone to make DoD at least somewhat interested in international standards.

DoD's largest on-going involvement in international business is foreign military sales—the sale of equipment, services, and training to allies and international organizations. In fiscal year 1989, foreign military sales totaled \$11 billion.²

DoD also buys from non-U.S. vendors to support its installations overseas, but no aggregate data are available for this. This use of foreign sources of supply during peacetime will decline if overseas bases

¹Department of Defense, Summary of Procurement Awards (Format Sum), October 1988–September 1989: work outside United States (including foreign firms for work in the United States) as a percentage of total procurement awards. Washington Headquarters Services, Directorate for Information Operations and Reports, Department of Defense, Washington, D.C.

²This excludes an additional \$4 billion of military sales to foreign governments directly from U.S. manufacturers and \$56 billion of undelivered orders against cumulative sales. Source: *Foreign Military Construction Sales and Military Assistance Facts as of September 30, 1989*, Data Management Division, Comptroller, Defense Security Assistance Agency (DSAA), Washington, D.C., undated.

close. During a military contingency or war, DoD plans call for buying a wide variety of supplies and services overseas, close to where forces are deployed. No estimates are available for these buys either. In such cases, DoD would need to tap into local markets quickly to find needed suppliers. If these markets use EDI in the future, DoD must quickly be able to use standard electronic formats accepted in these markets.

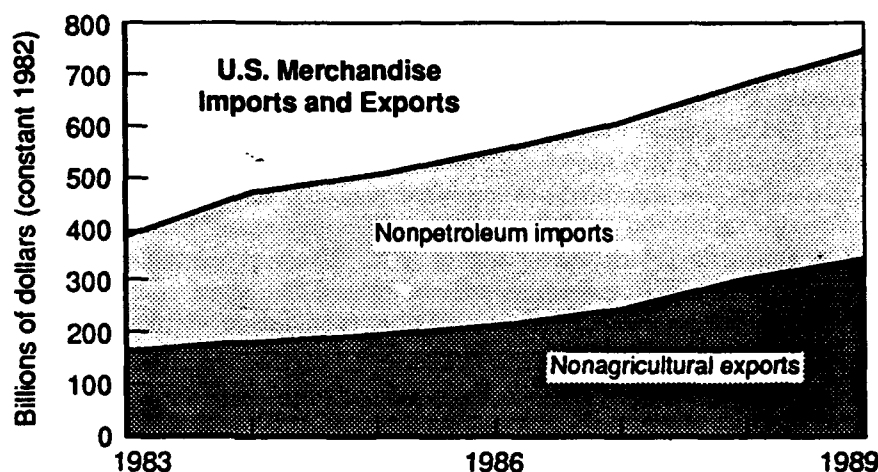
In short, DoD conducted at least \$17 billion of business with foreign governments or businesses in fiscal year 1989—a hefty sum, but still small compared to total DoD business and not enough to conclude that DoD's international business should significantly influence DoD's EDI decisions.

THE INCREASING IMPORTANCE OF INTERNATIONAL COMMERCE TO DoD'S VENDORS

International commerce is *indirectly* important to DoD, because it is important to a growing number of the over 300,000 vendors that are interested in doing business with DoD. It is in DoD's interest to have these vendors, its industrial base, as strong and globally competitive as possible. Figure 1 shows the steady increases in U.S. merchandise imports and exports over the last seven years—an increase of 92 percent, even excluding petroleum imports and agricultural exports. This globalization of the marketplace means that U.S. firms are turning increasingly to foreign suppliers and customers.³ DoD does not know the extent to which its vendors buy and sell outside the United States, but, given general trends toward globalization, the number is likely to increase if these firms stay competitive.

As DoD's vendors become more global and begin using electronic commerce, their international interests will influence what EDI message standards they want to use. Choosing what EDI standards to use is a business decision—it depends on what a firm's trading partners use, whether the firm is in a position to dictate to its partners what the standard will be, and what message standards fit their needs. If there are accepted, international EDI standards, they may be chosen.

³For an interesting discussion of how to define a "U.S. firm," given these trends, see Reich, 1990.



SOURCE: Bureau of Economic Analysis, 1986-1990.

Note: U.S. Merchandise Imports and Exports, 1983-1989, excluding petroleum imports and agricultural exports.

Fig. 1—U.S. international trade is increasing

THE IMPORTANCE OF INTERNATIONAL EDI STANDARDS, DESPITE TRANSLATION SOFTWARE

But does this growth in international commerce necessarily mean DoD should be concerned about international EDI message standards? Some would argue that choosing one message standard is unnecessary, because an EDI user can simply translate between standards. Most businesses using EDI already translate EDI messages to and from the electronic formats of their internal application software. So, the argument goes, it does not matter what standards are used. In reality, the problem is much more difficult.

Even when using the same message standard to implement EDI, trading partners must reach detailed agreement regarding exactly how the standard will actually be used. For example, many fields and even individual messages can be used in different ways. One buyer might use a purchase order message to order an item from a supplier, while another might use a release order message to do so. A third buyer might use a purchase order followed by a series of release orders. All are legitimate uses of message standards, but to transact

business smoothly, trading partners must agree on one method. To address these challenges, groups of EDI trading partners and entire industries are developing EDI implementation guides for each separate EDI message. Adding another (and growing) set of standards to this process increases its complexity dramatically. Further, each standard a firm-uses requires internal support and, ideally, participation in the standard-development process. Even now, these are not trivial tasks and contribute to the difficulty many firms are having in trying to expand their use of EDI. These problems will grow even larger as EDI messages are developed for more complex and time-sensitive business functions. Thus, translation software is not an adequate long-term bridge between EDI message standards.

THE PROSPECTS FOR ONE WORLDWIDE MESSAGE STANDARD

Given the problems coupled with increasing globalization, many argue that one worldwide EDI message standard is preferable. But the use of only one EDI message standard within even 10 years is unlikely for three reasons:

- Many public and proprietary standards are now in use, and some users will have no compelling business reason to change.
- There will always be certain EDI message requirements that are unique to an industry or even to a particular country or region. (These, of course, might be accommodated within a universal message standard.)
- The process of setting a worldwide EDI message standard is necessarily slower than one for a smaller body. Subsets of users will have business reasons to develop and use their own standards ahead of the worldwide body, which may not necessarily adopt those standards.

So instead of pursuing a single, universal standard, a practical and more realistic arrangement would be like that depicted in Fig. 2. (If this figure represented the current situation, the four ellipses would overlap little, if at all.) All standards would share a common syntax; data field, segment, and coding directories; and conventions for use, but standards at different levels could diverge in content and usage. For example, standards could have different messages to serve nation-specific needs. These unique messages would still have syntax in common with other message standards, and data fields used by other standards would share common definitions. These

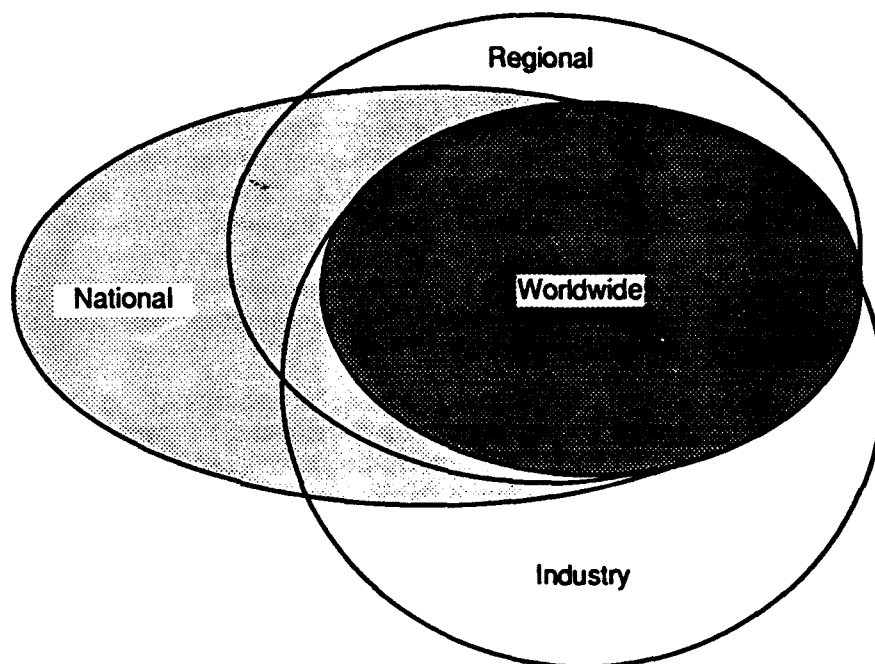


Fig. 2—A view of compatible standards at different levels

commonalities will be discussed further in Sec. 6. The ellipses in the figure should not be interpreted as showing a clear line between domestic (i.e., national) and international EDI transactions. Firms (and DoD) can and eventually will use EDI to support complete product development and production processes, not simply discrete buy-and-sell relationships. Data from one transaction will be linked to or even carried forward into others. These business processes can encompass a diverse and long supply chain and an equally varied but different distribution system spanning the globe. The distinction between "domestic" and "international" business processes blurs. For example, a firm may use EDI for invoices with some international customers and some in the United States. Distinguishing between domestic and international invoices in a single billing process adds work and in many cases does not make business sense.

Trying to distinguish between "international" and "domestic" standards becomes even more difficult, because EDIFACT and ANSI X12 standard messages already overlap. ANSI X12 standards are only

"domestic" in that they are developed in a U.S. standards process. Similarly, EDIFACT standards are only "international" in that they are developed in an international process. A firm could eventually use either ANSI X12 or EDIFACT (or some other standard) for all of its business transactions. The overlap between finalized X12 and EDIFACT messages is illustrated in App. C. The overlap is even greater if one considers messages under development. International standards can be used domestically if certain fields are ignored, e.g., any fields dealing with currency identifiers, currency exchange rates, and export and import requirements. Domestic standards can, of course, also be used internationally.

The distinction between "domestic" and "international" is more appropriately applied to the standards development processes, not the EDI message standards. Foreign trading partners have no direct, formal voice in a domestic standards development process, such as that for ANSI X12, but U.S. interests can have a direct, formal voice in an international process.

NO CONFLICT WITH OTHER INTERNATIONAL STANDARDS

As mentioned in Sec. 1, DoD is already committed to using three international standards to support EDI. These standards address areas of electronic commerce beyond actual EDI message structure and content addressed in ANSI X12, EDIFACT, and various industry and proprietary standards:

- The Consultative Committee for International Telegraph and Telephone (CCITT)⁴ X.400 standard for electronic mail interchange, used as the "envelope" for delivering EDI messages
- The CCITT X.500 standard for electronic directories which can be used for addressees of EDI trading partners
- The OSI Reference Model from the International Standards Organization (ISO),⁵ which provides a framework for open communication between computer systems across electronic networks.⁶

⁴CCITT is the organization that establishes recommendations for international communications standards.

⁵ISO is a voluntary, nontreaty organization. Its members are national standards organizations from 89 countries. The United States representative to ISO is ANSI.

⁶For a description of the OSI Reference Model, see Tanenbaum, 1988, pp. 14-26.

These international standards are widely accepted in the EDI community (if not yet in broad use) in the United States and elsewhere, and DoD is committed to using them. The OSI Reference Model has even been adopted by the entire U.S. government as a part of the Government Open System Interconnection Profile, mandated as a FIPS for all Federal government computer system networks.⁷ Further, no other public standards to serve the same purposes are under development or widely proposed. This wide acceptance does not mean these standards do not need improvement to be most useful for electronic commerce. There are serious suggestions for improving each. These will be discussed in Sec. 7.

In summary, given DoD's objectives for using EDI, it must pay attention to the standards of interest to U.S. businesses, regardless of whether the standards development process is international or domestic. As U.S. firms become more interested in international EDI standards, DoD must as well. Indeed, DoD may need to help U.S. firms understand the importance of worldwide standards to support open EDI.

⁷National Institute of Standards and Technology, 1988.

3. INTERNATIONAL COMMUNITY COMMITTED TO EDIFACT

The UN EDIFACT standard is the only EDI message standard with broad endorsement worldwide, despite the fact that only two EDIFACT messages are currently in final form. Below, we explain why this is so. First, we describe EDIFACT's origins, then the current status of EDIFACT standards and the standards development process. Next, the extent of EDIFACT's international acceptance is discussed, followed by a concluding section on shortcomings of the EDIFACT standard and standard-setting process.

EDIFACT: RESULT OF AN INTERNATIONAL CONSENSUS PROCESS

Work on nonproprietary standards for EDI messages began independently in the early 1970s in Europe and the United States.¹ Overlapping standards were developed by industry groups, as well as by national standards organizations. In Europe, several standards initiatives progressed, including Trade Data Communications (TRADACOMS) in the United Kingdom (UK). In the United States, ANSI chartered a new committee, ASC X12, to develop uniform, cross-industry standards for EDI business transactions in 1979.

Many saw that the benefits of EDI would increase if the many standards could converge. Standard developers in the UK were the first to propose to a UN body that international standards for business messages be developed. The UN body approached was the Working Party on the Facilitation of International Trade Procedures (WP.4) of the UN Economic Commission for Europe (UN/ECE).² This UN/ECE effort led to the publication in 1981 of the "Guidelines for Trade Data Interchange" (GTDI),³ intended to lead to one international message standard.

¹For more detailed descriptions of the history of EDIFACT standards, see United Nations Economic Commission for Europe, 1988, pp. 5-7; Department of Trade and Industry (UK), 1989, pp. 26-28; or UN/EDIFACT Rapporteurs Teams, 1990, pp. 9-10.

²United Nations Economic Commission for Europe, 1988, p. 5. WP.4 is actually a subsidiary of the UN/ECE Committee on the Development of Trade. The UN/ECE will be explained further below.

³Ibid., p. 6.

But the GTDI guidelines did not address the many independent standards already under development and in use. At least the predominant standards, GTDI and ANSI X12, had to be reconciled. The WP.4 commissioned a joint European/North American ad hoc group, known as United Nations Joint EDI, to do so in 1985. Group meetings were held in Washington, D.C., and London with ANSI X12 representatives participating. By September 1986, the emerging standards received their new name, EDIFACT, recommended by the ad hoc group and approved by WP.4. By 1987, WP.4 approved the EDIFACT syntax based on the group's work, and ISO unanimously approved the syntax as an international standard (ISO 9735). By the end of the year, EDIFACT rapporteurs had been appointed for North America, Western Europe, and Eastern Europe, and the first EDIFACT message was approved for trial use.

In Europe, the EDIFACT syntax is viewed as an international compromise, a convergence of the dominant standards at the time brought about through compromise between Europeans and North Americans. In the United States, EDIFACT is rarely referred to as the result of a joint process, even though ANSI X12 representatives during this phase of EDIFACT development confirm that it was indeed a joint process and that the Europeans made even more compromises than the United States did.

CURRENT STATUS: EDIFACT STANDARDS AND DEVELOPMENT PROCESS

Status of EDIFACT Standards

By the end of 1990, only two EDIFACT messages had been formally approved and registered by WP.4: the invoice and the purchase order.⁴ Such a short list gives a misleading impression of the progress of EDIFACT messages. Thirty-nine more messages have been technically assessed and are in either draft form or trial use.⁵ Sixteen of these are forecast to be finalized by September 1991.⁶ Many more

⁴EDIFACT messages are assigned a status depending on their position in the approval process. Status 0 means a draft document having undergone technical assessment but issued for information only; Status 1 means a message for formal trial use; Status 2 means a message that has been formally recommended and registered by WP.4. The invoice and the purchase order are Status 2 messages.

⁵See App. B.

⁶Appendix B lists these messages.

messages are being worked on now by EDIFACT working groups worldwide.

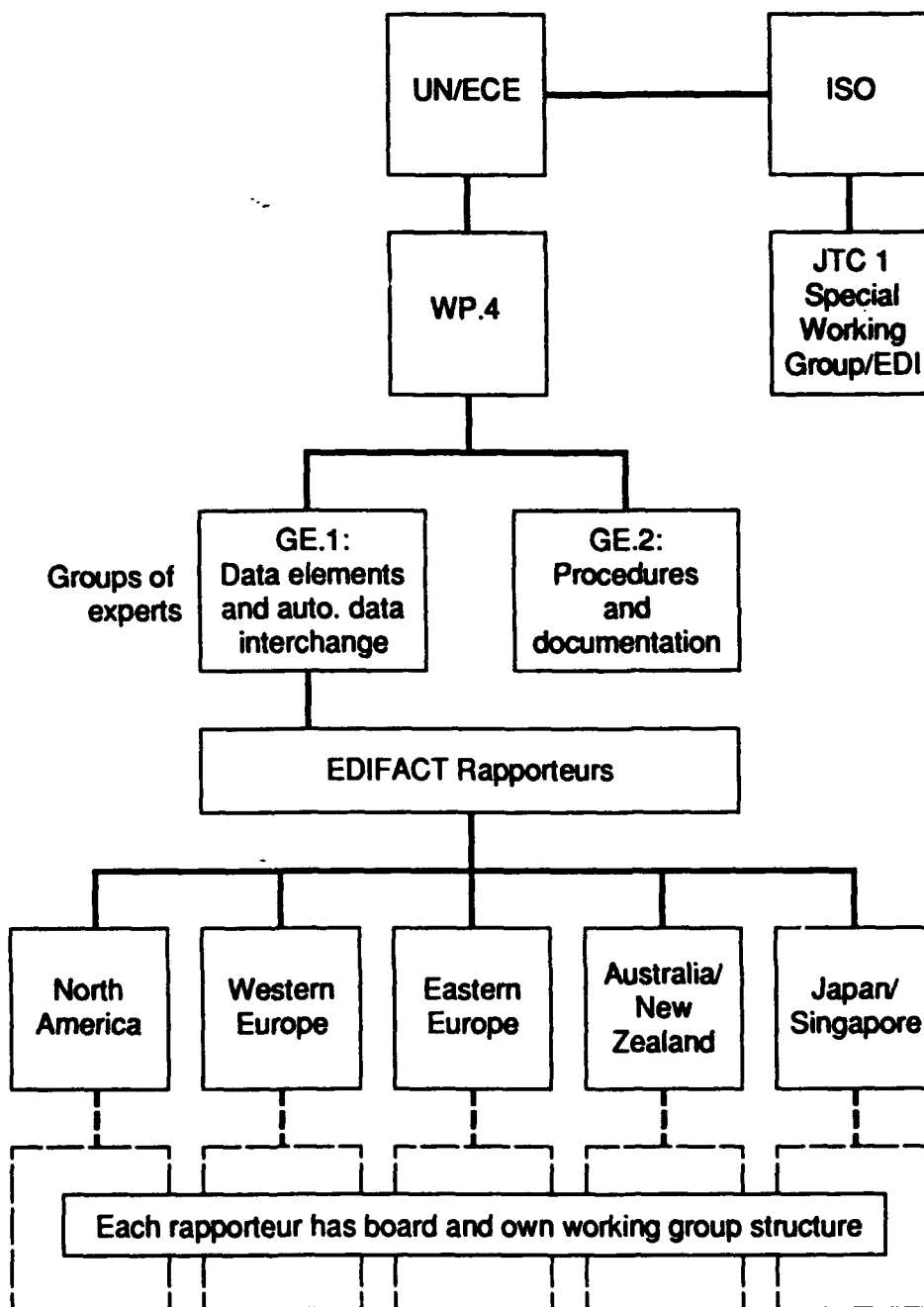
As mentioned above, the EDIFACT syntax is an ISO standard. The UN Trade Data Element Directory (UNTDDED) has also been approved as ISO 7372. This directory, now being enlarged, defines the building blocks for EDIFACT messages. This ISO standard is formally maintained by the UN/ECE Trade WP.4, i.e., the EDIFACT process. Two other EDIFACT directories exist: one defining data segments and one defining code sets used in messages.⁷ Finally, there are also guidelines for EDIFACT message design.

EDIFACT Standards Development Process

Figure 3 presents the structure of the EDIFACT standards development organization. The UN/ECE, at the top of the figure, is actually one of five regional bodies established by the UN Economic and Social Council. It was created after World War II by the United States and all Western and Eastern European countries to promote closer economic and technical cooperation and now has participants from 35 UN member states. Any other interested UN member state may participate in UN/ECE meetings as well, and many do (e.g., Japan, Australia, Netherlands, Hong Kong, Singapore) when the subject under consideration is of concern to them. WP.4 is a subsidiary body set up in the 1960s by the UN/ECE Committee on the Development of Trade to promote trade facilitation measures, initially concentrating on documents and procedures.

The status of EDIFACT message standards is approved by the UN/ECE WP.4. Besides the participating UN member states, several international trade and standards organizations are official observers, including the Commission of the European Communities (CEC), the European Free Trade Association (EFTA), the Customs Cooperation Council (CCC), and the General Agreement on Tariffs and Trade (GATT). These organizations have effectively the same rights as full participants, since, by tradition, the ECE does not make decisions based on simple majority vote but by consensus. ISO attends all WP.4 meetings and cooperates closely with it, as do its standards committees and its Joint Technical Committee 1 (JTC1) Special Working Group/EDI. (Appendix E lists all UN member states participating in WP.4 and all international organization observers.)

⁷See App. A for a description of the parts of an EDIFACT message.



SOURCE: UN/EDIFACT Rapporteurs' Teams, 1990.

Fig. 3—UN/EDIFACT standards organizational structure

WP.4 meets twice annually to address trade facilitation issues, including EDIFACT. It hears reports and recommendations from rapporteurs from five regional EDIFACT boards: North America, Western Europe, Eastern Europe, Australia/New Zealand, and Japan/Singapore. It operates on a consensus basis, conferring with its Groups of Experts (GE.1 and GE.2), one on data elements and automated data exchange and the other on procedures and documentation. Members of these groups are appointed by their governments or by organizations recognized by the UN/ECE. GE.1 is relevant to the EDIFACT process specifically.

WP.4 itself does not develop messages and, indeed, can offer little staff support to EDIFACT because of limited UN resources. Message development is done by volunteers working in groups set up by each regional EDIFACT board. Each board decides how to organize and support these groups. Twice yearly, delegations from each board and its working committees meet at joint rapporteur meetings on message development, quality assurance, technical issues, and documentation and procedures. Between meetings, the boards and working groups keep in touch more informally via their rapporteurs or from committee to committee.

The EDIFACT structure and procedures are relatively new and are maturing. Formal procedures for message development and maintenance were just instituted in 1988. There were only three EDIFACT boards until 1990, when both the rapporteurs for Australia/New Zealand and Japan/Singapore were appointed.

THE DRAMATIC GROWTH OF THE WORLDWIDE COMMITMENT TO EDIFACT

Two years ago, those involved in EDIFACT were a clear minority in the worldwide EDI community—and sometimes an unwelcome one. ANSI X12, TRADACOMS, proprietary standards, and industry standards dominated. Today, the picture is very different: Many countries and industries have boarded the EDIFACT “train,” and it is gaining speed. The EDIFACT syntax, directories, and even process may change, but an impressive share of the international community has come aboard to help shape a worldwide EDI message standard and process—to make it work so that EDI will work.

Others have chronicled in detail the dramatic growth in interest in EDIFACT in particular countries.⁸ Here we will only highlight a few of the significant commitments that show the importance of EDIFACT worldwide. U.S. EDIFACT activity will be addressed in the following section.

European countries are big players in international trade. The 12 members of the European Economic Community (EEC) alone account for some 39 percent of world trade.⁹ In Europe, especially, interest in EDIFACT has been strong, partially because the EEC is committed to eliminating major trade barriers between its members by January 1993. EDI, and EDIFACT specifically, is seen as an important tool to facilitate this change. In fact, the well-funded secretariat for the Western European EDIFACT board is a function of the CEC, supported by EEC member nations.¹⁰ But the commitment to EDIFACT goes beyond EEC members to include the six countries in the EFTA who participate in the Western European EDIFACT Board (WEEB) and contribute financially to its secretariat.

Perhaps the most significant sign of the commitment of these countries to EDIFACT is that, in 1990, the European Committee for Standardization (CEN), the standards body for Europe, designated WEEB as an associated body and mandated that the 18 European governments use EDIFACT standards when they implement EDI. Thus, any vendor—or government—dealing with these 18 governments must use EDIFACT. (This alone has significant implications for DoD, given the military alliances between the U.S. and European governments.)

Two dominant EDI message standards are currently used in Europe: TRADACOMS, a UK standard, and ODETTE, developed by the European auto industry. In 1989, a blue-ribbon public-private sector task group in the UK recommended that UK firms use EDIFACT or TRADACOMS standards.¹¹ In the same year, ODETTE committed to migrating to EDIFACT.¹²

⁸See, for example, Fawcett, 1990; INPUT, 1989; and *EDI News*, March 29, 1990, pp. 3-4.

⁹International Monetary Fund, 1990.

¹⁰Trade Electronic Data Interchange Systems, a program of the CEC, goes far beyond secretariat responsibilities to include sponsorship of cross-industry coordination and prototypes.

¹¹Department of Trade and Industry, 1989.

¹²ODETTE standards already complied with the EDIFACT syntax, having followed ISO 9735. According to ODETTE, approximately 1,500 trading partners now use ODETTE standards.

Several other major trade facilitation and industry groups based in Europe have also committed to EDIFACT, have EDIFACT prototype projects underway, or have been created to promote, use, and help develop EDIFACT standards. These groups include the European Chemical Industry Federation, the Society for Worldwide Interbank Financial Telecommunication, the Electronic Data Interchange Forum for Companies with Interests in Computing and Electronics, the International Reinsurance and Insurance Network, Data Interchange for Shipping, and the International Data Exchange Association. Several of these are working with their U.S. counterparts.

Outside of Europe and the United States, there has been less EDI activity, but the addition of the two new regional EDIFACT boards in 1990 was significant for the EDIFACT process. In Australia and New Zealand, where X12 has been well used, there are signs that firms will begin using EDIFACT messages when available. It is not yet clear how firms in Singapore and Japan will participate in EDIFACT. In Japan, few firms now use public EDI standards, and it is not yet clear to what extent they will adopt EDIFACT.¹³ In Singapore, EDI is being incorporated into a large effort to support international trade electronically.

There is little EDI activity elsewhere in the world, so commitment to international standards is not yet an issue. In 1990, though, firms in Mexico and South America began to show interest in participating in EDIFACT, possibly through an expanded North American EDIFACT Board (NAEB). South Africa already "observes" WP.4 activities by correspondence.

Finally, the CCC, an international organization of 104 customs agencies, is a prime player in the EDIFACT process. CCC members are committed to worldwide EDI standards for their customs functions and are working to make the EDIFACT standards and process "deliver" what they need. Their efforts show in the number of EDIFACT messages for customs functions far along in the EDIFACT pipeline. They are also working with the United Nations Conference on Trade and Development to convert the Automated System for Customs Data (ASYCUDA) to EDIFACT. By late 1990, ASYCUDA was used by 27 customs agencies in developing countries to improve trade procedures, with 20 more countries preparing to implement it.

¹³See Japan Information Processing Development Center, 1990; Iwasaki, 1990; and *EDI News*, January 29, 1990, pp. 1-3.

SHORTCOMINGS IN EDIFACT STANDARDS AND DEVELOPMENT PROCESS

Despite the growing commitment to EDIFACT, it would be difficult to find anyone in the EDIFACT process without suggestions for improving the syntax, messages, and standard-setting process. Clearly, its process and even the standards will change in the future in response to at least some of the concerns described below. This is only a sampling of weaknesses observed so far. Other concerns that also generally apply to X12 standards are described in Sec. 5.

Too Few Messages, Not Stable Enough

As of this writing, EDIFACT had only two finalized messages, although many others are in process (with 16 more due to be finalized by September of 1991). A more important criticism is their lack of stability. The EDIFACT standards process is relatively young and still changing. In 1990, it underwent a tumultuous quality control process, during which many messages in the pipeline were changed to align them with a consistent set of data-element definitions and conventions. Few argue with the objectives of the process, but many were (and some still are) concerned about how the process was carried out and the effects on users.

The process faces another challenge: integrating and synchronizing the work of the two new EDIFACT boards and their eventual working groups.

A Too-Slow Process

It takes a long time to finalize messages. But the pipeline is full, and schedules and even computer support applications are being refined to allow better coordination between regional boards.

A Government-Based, Regional Process

WP.4 is a UN body requiring official representation from governments. Further, its board structure is regional. Some argue that this gives undue weight to governments and not enough to private sector EDI users, while inappropriately introducing politics—or at least diplomacy—into the process. Also, given that the standards are to serve industries that span the globe, a regional structure at times

seems artificial. International industry groups develop proposed standards on a global basis, then have to introduce them regionally. Others respond that WP.4 serves only as a forum for consensus of the EDIFACT rapporteurs and that each rapporteur represents a board structure with ample opportunity for industry participation. Further, developing draft standards within international industry groups makes sense, and the regional structure has not yet hampered them.

Appropriateness of WP.4 Questioned

Some argue that WP.4 is not a standards body—and is European. Right on the first count, wrong on the second. WP.4 is more than a standards body and need not have been the chosen “home” of global EDI standards. Wherever the home is, it needs to (1) work reasonably fast, (2) offer an open and fair process for standards development and modification, and (3) include anyone in the international community interested. The ANSI X12 body meets the first two needs but is, by definition, a domestic standards process. ISO is often suggested as an alternative to WP.4. However, according to some standards experts, while it meets the second two needs, it is slow and is not well suited to developing and maintaining fairly volatile standards. WP.4 already works closely with ISO and, so far, ISO has adopted the EDIFACT syntax and UNTDED quickly. Ultimately, all EDIFACT standards may become ISO standards as they stabilize.

WP.4 is as international as UN members choose to make it. While it is a UN/ECE body that was originally formed with U.S. and European members, its members now span the globe and have equal opportunity to participate. The recent addition of the two new rapporteurs reinforces this fact.

4. EDIFACT AND X12 IN THE UNITED STATES

In this section, we explain why there has been little interest in the United States in EDIFACT standards and describe U.S. involvement in the EDIFACT process so far and ANSI X12 efforts to bring about alignment of the X12 and EDIFACT standards.

FEW U.S. FIRMS USE OR SHOW INTEREST IN EDIFACT

Somewhere between 4,000 and 10,000 U.S. firms now use EDI.¹ It is not, however, surprising that very few of these use EDIFACT standards, know much about them, or are interested in them for three reasons:²

1. Roughly a third of U.S. firms using EDI use proprietary standards rather than X12, EDIFACT, or industry standards.
2. Far more X12 standards have been released for use (26 transaction sets) than EDIFACT (two messages).
3. Most U.S. firms using EDI are still in a pilot stage or are trading with fewer than 50 partners; half had fewer than ten partners in 1989.³ Since almost all firms begin with domestic trading partners, there has been little demand for EDIFACT use.

A notable exception to the lack of interest in EDIFACT in the United States is inside the Federal government itself: The United States Customs Service, working with other members of CCC, has strongly endorsed EDIFACT.

¹No hard data are available, but private market research firms have estimated between 5,000 and 7,000 firms or even up to 10,000 firms. See, for example, EDIA, 1989, which contains estimates of 4,000 firms worldwide (p. 37) and 10,000 firms worldwide (p. 33). Wright, 1989 (p. ix) reports that a survey by the market research firm INPUT found that 34 percent of "Fortune 1,000-class public and private firms, large universities, and government agencies" now use EDI, and an additional 20 percent are actively planning to use it. Masson and Ferguson, 1989 (p. 16), reported the results of a 1989 survey with respondents having median sales of \$180 million. They found that 17 percent of these firms used EDI. A total of 52 percent used EDI or reported planning to do so within 2 years.

²INPUT, 1989. This document reports the results of a 1989 survey of active EDI users in North America. Nearly one third had limited or no knowledge of EDIFACT.

³Electronic Data Interchange Association, 1989, p. 7.

Despite this general lack of interest and understanding of EDIFACT, many EDI users, especially in service industries, feel that a single global standard is important.⁴ In July 1988, ANSI X12 members voted on the question of EDIFACT and overwhelmingly endorsed the principle of a universal standard.⁵ Another survey of members in late 1990 showed an even stronger interest in a global standard: 97 percent were in favor of one (but the survey response rate was only 14 percent).⁶

ALREADY AN IMPORTANT EDIFACT PLAYER

Today, the majority of the world's EDI users are in the United States, and ANSI X12 is probably the most widely used public, nonindustry standard in the world. The use of EDI elsewhere, especially in Europe, is growing, but, given the size and influence of its economy, the United States will always be an important player in determining what EDI standards are used. The United States is already an important player in the EDIFACT standards process.

Since 1986, ANSI X12 had been responsible for providing advice on technical positions to the United States representative to UN/ECE, who is from the Department of Transportation. This representative has several advisors who constitute the U.S. delegation to the WP.4 and the GE.1. The United States also has had an EDIFACT rapporteur since 1987—one of the first three appointed.

In 1988, NAEB was created to represent the United States and Canada, with the Data Interchange Standards Association serving as secretariat. In 1990, the board had 14 member organizations with 15 more participating regularly. Although few, the members include major firms in the United States, e.g., Sea-Land, Woolworth, IBM, Chase Manhattan Bank, and E.I. Dupont de Nemours & Co. This count is not a full measure of U.S. industry involvement in EDIFACT, for ANSI ASC X12 has integrated EDIFACT message development into its regular X12 message development process. So, in effect, any of the over 300 firms that are members of ANSI ASC X12 can work on EDIFACT message development. The NAEB's role in the United States does not include actual message development, but does include technical assessments of EDIFACT messages, promotion, and documentation and

⁴INPUT, 1989, p. 25.

⁵Department of Trade and Industry, 1989, p. 27.

⁶Mail survey of ANSI X12 members by the Data Interchange Standards Association, November/December 1990.

liaison work with X12 subcommittees and the working groups of other EDIFACT boards.

SERIOUS EFFORTS UNDERWAY TO ALIGN X12 AND EDIFACT

A 1989 debate at the first International EDI Congress revealed that U.S. leaders in the EDI standards community were sharply divided on the merits of EDIFACT.⁷ One argued that X12 was already an international EDI standard and EDIFACT must be made compatible with it. Another went so far as to emphatically state that EDIFACT was "wrong" and should be left to "die on the vine."⁸ But soon after this debate, the new chair of ANSI ASC X12 struck a more conciliatory note. In an unusual "open letter to the global EDI community," the new chair reaffirmed ANSI ASC X12's commitment to the development of EDIFACT standards and reminded ASC X12 members that they had been instrumental in the initial creation of EDIFACT and, in fact, had "overwhelmingly accepted the responsibility of integrating the development and maintenance of UN/EDIFACT into the mainstream ASC X12 environment" through a 1988 written ballot.⁹ He went on to state that both X12 and EDIFACT could and, for the foreseeable future, must coexist. He concluded with a visionary statement:

In my view, the long-term goal must be to integrate regional/ national standards into UN/EDIFACT, at least for common functions. The EDI user community will eventually tire of supporting multiple standards, demanding a single one that can be used with all of their trading partners. If this is to happen in the U.S., however, technical and procedural alignment must be completed and the set of UN/EDIFACT messages must be capable of satisfying ASC X12 standard-users' needs. Only then can integration take place. The transition will likely take years to complete as the community of UN/EDIFACT-capable trading partners swells to the point that thousands of companies can justify the investment in UN/EDIFACT, as they did in ASC X12. . . . I would like to make public my full support to ASC X12's stated commitment to UN/EDIFACT. We have a lot of work ahead to achieve maturity in the UN/EDIFACT environment.¹⁰

Spurred on by this leadership, ASC X12 efforts to resolve differences between EDIFACT and X12 escalated. The NAEB had already

⁷Notto et al., 1989.

⁸Ibid., pp. 126, 128.

⁹Hutcheson, undated (1989?).

¹⁰Ibid, p. 2.

developed an ASC X12 document describing how to translate the one available EDIFACT document to and from X12,¹¹ and ASC X12 had completed a detailed comparison of X12 and EDIFACT syntaxes. Following his open letter, the ASC Chair took an important step in early 1990 by appointing an ASC X12 X12/EDIFACT Alignment Task Group (chaired by the NAEB Board Chair) to develop a plan to achieve alignment of X12 and EDIFACT by 1994. In late 1990, the group became an ASC X12 standing committee. Even as an ASC X12 committee, the group cannot alone bring about alignment or even set it as an ASC X12 goal. It can develop positions that have to be ratified by the ASC X12 steering committee and membership. To confirm the interest of ASC X12 membership in its charter, the group polled the membership in late 1990. The poll, mentioned above, showed that the majority of the 14 percent of the X12 members responding were in favor of alignment by 1993, if not earlier. Given the low response rate, the Task Group still cannot be assured of the X12 members' strong support in the difficult tasks ahead.

This ASC X12 Task Group's work is critical to determining the future relationship of X12 and EDIFACT. Their vision statement calls for one global EDI standards organization and process with national, industry, and regional standards bodies working under "the broad umbrella" of a global EDI standards organization.

The jury is still out on if, and if so how well and fast, the group will be able to achieve its vision. Alignment will mean changing both ASC X12 procedures *and* the standards themselves. This means changes for EDI users in the United States. Many U.S. participants in the EDI standards process view the EDIFACT process with some suspicion. Their perspective is graphically illustrated in Fig. 4. They do not want "alignment" to mean "capitulation" to European-dominated standards. There is also concern that adopting EDIFACT will make the state of EDI standards go backwards, going over ground that X12 has already covered. They do not perceive the current EDIFACT standards as already a compromise, as the Europeans do, but as standards that need to now be revised in a compromise with X12. The leadership of WEEB appears to be willing to work with the X12 alignment efforts, but perceives these as requiring changes primarily on the X12 side, unless there are technical or business reasons that EDIFACT should compromise.

¹¹ North American EDIFACT Board, 1989.

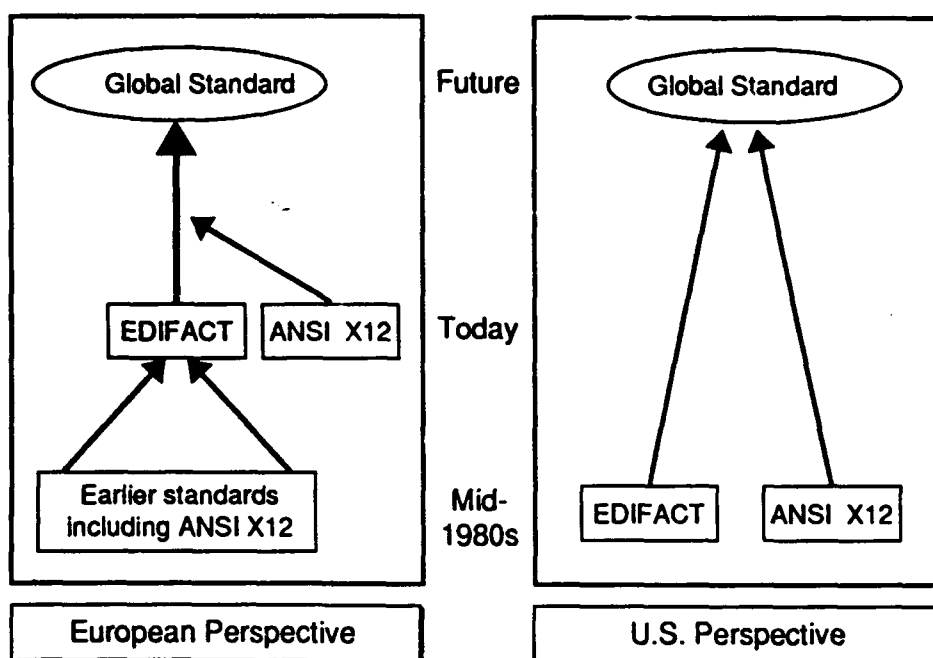


Fig. 4—U.S. vs. European perspective on standards convergence

Despite these different perspectives, some work is progressing on aligning the standards and the standards processes. The ASC X12 committee has already developed its plan for alignment. It identified no insurmountable technical obstacles. Those in technical EDIFACT groups in North America and Europe are quietly working on what alignment means to syntax, data elements, segments, and coding. Others are working on committee tasks to align the standards-development processes themselves.

5. INTERNATIONAL STANDARDS COMMUNITY SHARES U.S. CONCERNS

Those developing EDI standards worldwide share a variety of concerns regarding how *all* existing EDI standards need to improve to serve innovative business practices that can take full advantage of the potential of electronic commerce. In fact, parallel and, for the most part, independent work is being conducted in the United States and Europe on some issues. This section describes several of these issues as illustrations of what *any* future EDI standards will need to address to serve business well and therefore be accepted.

BUSINESS INFORMATION MODELS FOR CREATING AND IMPLEMENTING STANDARDS

An EDI standards expert recently quipped, "we're paving cow paths" when describing the message development process. He was referring to the fact that most messages reflect the paper forms they replace rather than take full advantage of their electronic form to change business practices. Business information modeling is a technique that can help EDI message developers and users cut through the assumptions of a paper-based business world to an electronic marketplace.¹ EDI working groups on both sides of the Atlantic (and likely elsewhere) are working separately on ways to apply these techniques better.²

A BROADER DEFINITION OF EDI: MOVING BEYOND TRADE

So far, most EDI efforts have focused on facilitating *trade*, the buy-and-sell relationship. EDI can be used to support the entire business cycle from product design, manufacture, distribution, and sales to product support, e.g., with telediagnosics and on-line manuals. This

¹For an example of the application of such a technique, see CEFIC, 1989.

²Two groups working on this are the Trade Message Group (MD1) under WEEB and the ASC X12 Subcommittee D, Task Group #2, EDI Business Practices. The Special Working Group on EDI (SWG-EDI) of the ISO/International Electrotechnic Commission JTC1 is also exploring the usefulness of business modeling to improve EDI (see Kane, et al., 1990).

calls for a broader definition of EDI *and* the inclusion of digitized product data in EDI messages or linked to them.

One major effort to address this broader role of EDI is DoD's Computer-Aided Acquisition and Logistic Support (CALS) Program now integrated with DoD's electronic commerce initiatives. The program's objective is to keep information on weapon systems in digitized form throughout the weapon system's life cycle: design, production, modification, and maintenance. Hundreds of DoD contractors are working within the program in a set of committees. They are addressing how CALS data will fit into EDI transactions or accompany them. They are also involved in exploring how CALS and EDI message standards will fit within a special form of the X.400 standard.

EDI leaders in Europe (and likely elsewhere) share the same concerns as those in the United States regarding CALS data in electronic commerce and are interested in the deliberations within the CALS program. What is decided there is likely to have international implications, but there is no formal process for non-U.S. interests and expertise to contribute to the discussion. No international standards process comparable to CALS exists.

Another effort to define EDI more broadly is under way in a Special Working Group on EDI (SWG-EDI) of ISO's JTC1 (working with IEC Electrotechnic Commission). This group is drafting a conceptual model for EDI that expands the definition of EDI beyond trade to include rule-based information data exchanges for manufacturing, medicine, scientific research, and more.³

IMPLICATIONS OF INTERACTIVE EDI

Most EDI message standards are now designed to be handled in a batch mode, not interactively. But many internal automated business applications are interactive, and it is only a matter of time until businesses will want to work interactively with their suppliers and customers. The airline industry is an important exception to this observation. Interorganizational airline reservations have been operating interactively for years, but they use neither X12 nor EDI-FACT standards. The tourism industry is already pushing EDI standards into this area within the EDIFACT process.

³Kane et al., 1990, p. 24.

Interactive EDI has implications for message design as well as the interconnection between trading partners. It may even call for changes to OSI to facilitate near real-time, interactive exchanges between organizations after a connection is made between them.

HOW X.400 WILL SUPPORT EDI

To be truly accepted, EDI must have true interoperability between autonomous organizations and across telecommunications networks. Users must be confident that their transactions are delivered quickly, confidentially, and completely, with an audit trail. One important component of this capability is message-handling standards. As mentioned earlier, experts in Europe and North America are exploring what form of X.400 best supports EDI message exchange. An option favored by many is to use a form of X.400 developed specifically to exchange EDI messages. CCITT's F.435 recommendation defines how it would be used, and X.435 defines the message protocol.⁴ PEDI has several important EDI message-handling capabilities, including the following:⁵

- The capability to allow documents to be appended to EDI interchanges, such as engineering documents
- The capability to reference other EDI interchanges within another interchange, e.g., referencing purchase orders within an invoice
- Alternative notification, non-repudiation, and transfer capabilities, e.g., positive notification to the sender that an interchange has been received or forwarded and protection for sender and receiver from false denials of originating or receiving an exchange
- The capability to indicate an expiration date for an interchange or indicate previous messages made obsolete by an interchange, e.g., an amendment to a purchase order making the original purchase order obsolete.

Few, if any, users have started to implement PEDI, so it is not yet clear how well it will work or if it will be adopted globally.

⁴CCITT, 1990a and 1990b. These recommendations were accepted in November 1990 by the CCITT study groups responsible for them with minor changes. Before they become formal CCITT recommendations, CCITT members must ratify them.

⁵For a summary of these capabilities, see GE.1, 1990.

CERTIFICATION OF TRANSLATION SOFTWARE

As mentioned in Sec. 2, many commercial software packages are available to translate EDI messages from one format into recognized EDI standards. Unfortunately, it is difficult for users to be certain that their software uses the standards correctly, following syntax rules and message structure correctly. Several individuals involved in the EDI standard-setting process in Europe and the United States have asked whether and, if so, how such software might be certified as meeting certain translation standards. In late 1990, WP.4 asked each EDIFACT rapporteur to suggest what organization could serve as the central point in their region to play such a role in some way. The question is still open.

VERSION CONTROL AND "NONMESSAGES"

Related to the above issue is the question of controlling evolving versions of EDI message standards and "nonmessages,"⁶ i.e., message formats that EDI users, industry associations, or even national standards bodies develop using a standard's rules before they are officially accepted as message standards.

Version control is a technique used now by X12 (and is being implemented by EDIFACT in a similar way) to keep track and inform trading partners of what version of particular messages a firm is using. Given the volatility of message standards today, it is an essential feature of a standard-setting process to facilitate exchanges with many trading partners.

The solution to the nonmessage problem is less obvious but may combine some sort of certification with version control. For example, an industry association (or even a national standards group) might develop a message using EDIFACT syntax and the current data element and coding directories. The message might be introduced into the standards process as a draft, while, at the same time, some firms begin using it in its nonmessage form. Given the length of the standards processes, many users could eventually exchange such messages in one or many forms. Is there some way (1) to give assurance that the draft message follows certain standards rules, (2) to identify these nonmessages in some way so that trading partners wanting to use them could agree on *what* exactly they were using, and (3) to facilitate the transition from the nonmessage to the actual finalized

⁶A term used by the Western European EDIFACT Board.

messages when they finally emerge from the normal standards process? An internal WEEB study has just explored these issues, but the results are not yet generally available.

RESOLVE LEGAL QUESTIONS

EDI experts globally have been attempting to resolve legal questions arising as the world moves toward electronic commerce. These need resolution across borders if electronic commerce is indeed to "take off."

In the United States, much attention has been paid to identifying and proposing solutions to legal questions raised by electronic commerce within and outside of the Federal government. In the international arena, the legal issues are similar but are even more complicated, because so many legal systems are involved. WP.4 now has expert advisors (including one from the United States) addressing legal issues and TEDIS, the secretariat for WEEB, has created a committee to do so. EDI users in France have worked with legal experts in government to facilitate electronic commerce. Singapore faces a combination of legal issues, because the country's traditional business practices rely on unwritten understandings between thousands of small businesses. How does EDI change these essentially legal agreements?

SMALL BUSINESS ACCESS TO ELECTRONIC COMMERCE

DoD's objective is to implement electronic commerce in a way that will not constrain but may even improve small business access to DoD business, as mandated by Federal law and regulations. Other governments share the same concerns. There is interest outside the United States (e.g., in France) in the DoD's proposed Intelligent Gateway Processor (IGP), which DoD plans to use to facilitate access by small businesses to electronic commerce.

There are several other efforts worldwide to address this issue. ASYCUDA, described in Sec. 3, is an interesting example of an approach to EDI that facilitates access by underdeveloped countries to EDI-based customs procedures. It may offer lessons on design and implementation for small businesses. France has experience with small businesses using its nationwide Minitel system heavily to receive and place orders. CHAMBERNET is an initiative of seven European countries to create a common electronic database of products sold by

private companies, small and large, standardizing product names across languages.⁷ The extensive groundwork to create this personal-computer-based system could eventually pay off in the form of truly international electronic marketplaces for thousands of products, helping to "level the playing field" between small and large businesses, as EDI potentially can do.

X.500: A STANDARD WITH NO USERS

The last illustration of a concern of EDI standards developers worldwide is the actual usage of the ISO X.500 standard for electronic address directories. Although most agree that this standard is the one to work with to create such directories, if there are any X.500 directories to support electronic commerce, they are not widely used. Such easily accessible directories, large ones or linked smaller ones, are critical prerequisites for DoD's plans to have electronic commerce widely used within five years.

⁷CHAMBERNET Europe, undated.

6. RECOMMENDATIONS: DoD'S USE OF EDI STANDARDS AND ROLE IN THEIR DEVELOPMENT

The following recommendations, based on the findings summarized in the preceding sections, address DoD's use and support of EDI message standards; its role in the message standards development processes; and concerns it should help address to improve EDI message and nonmessage standards. These recommendations are not aimed at facilitating benefits from electronic commerce in general, but at achieving DoD's objectives for using electronic commerce.

DoD'S USE OF EDI STANDARDS

As described at the outset of this report, DoD's choice of standards is meant to meet three objectives: (1) to ease implementation of EDI by the dozens (eventually hundreds) of DoD locations affected; (2) to "follow" industry, i.e., not to impose upon vendors standards that are not useful and well used by the private sector; and (3) not to unnecessarily burden the thousands of small businesses interested in doing business with DoD. DoD should maintain these objectives. Because X12 is the most widely used public EDI message standard among DoD vendors today, DoD should continue to concentrate its electronic commerce implementation efforts on X12 messages. At the same time, DoD should do nothing to preclude the use of EDIFACT message standards by DoD vendors and should support their development and improvement to meet DoD and vendor needs. Specifically, DoD should

- Use X12 as the default message standard, but accept and send any comparable, finalized (Status 2) EDIFACT message as an alternative at the option of vendors
- Include in its EDI implementation guidelines the conventions for the use of finalized EDIFACT messages, as well as those for X12 messages.

These recommendations mean more work for DoD to support EDIFACT standards as well as X12 standards. But for the next few years, this will add little work to DoD's efforts, because so few EDIFACT messages are available. Relevant EDIFACT message stan-

dards should be built into the capabilities of DoD's planned IGP, which will serve as the transparent link for DoD (and vendors if they like) to EDI standards and electronic networks. Given that IGP will incorporate commercial software where available, the translation to and from EDIFACT formats will likely be handled by commercial translation software-already with these capabilities, reducing the additional work required for DoD to support EDIFACT messages and incorporating improvements and new business needs.

Importantly, the international message standards are referred to here as the EDIFACT message standards, but these are not static: They will change over time to incorporate improvements and new business needs.

DoD should continue its plans for using CCITT X.400 and X.500, as well as following ISO's OSI Reference Model, as described in Sec. 2. Although these standards may need improvement in the global community, they are the ones being shaped to facilitate electronic commerce. Areas where they need improvement are suggested below.

DoD'S ROLE IN THE EDI MESSAGE STANDARDS PROCESSES

Given the above recommendation to support the use of EDIFACT message standards by its vendors, DoD should also participate in the EDIFACT and X12 standards processes, with two objectives: (1) to bring the current standards into alignment and (2) to change the processes so that the standards remain aligned. DoD is an important participant in the standards-setting processes, given its potential influence on so many vendors. Its objectives matter. If resources permit, DoD's role in standards should go beyond its current roles in X12 as a catalyst and an observer. At this critical time in standards development, DoD should increase its participation as a substantive member of message development teams and, if approved by ASC X12, as a member of the alignment committee. Further, to the extent resources allow, it should participate directly in EDIFACT proceedings as a member of the NAEB. Those involved in directing the introduction of electronic commerce into DoD should also serve directly as members of the U.S. delegation to WP.4.

We describe below what DoD should work toward. First, we describe what "aligned" EDI message standards may ultimately look like and how the alignment process may unfold. Then, we address the even more difficult objective of developing processes to maintain alignment.

Aligned EDI Message Standards

Having aligned standards does not necessarily mean having one universal set of standards that all organizations use. Rather, it means that standards share (1) a common syntax (including enveloping); (2) data element, segment, and coding directories; and (3) message conventions.¹ For historical and practical reasons, regional, national or industry standards will continue to be used, fitting together as illustrated in Fig. 2. Their number will probably shrink over time as the stable and useful global standards are developed. Figure 5 compares depictions of the relationships between standards today, in the near future, and after alignment has been accomplished. In 1990, there is already some overlap between standards. By 1994, standards could be far closer to alignment, if not totally aligned. They could all share a compatible set of building blocks. Regional

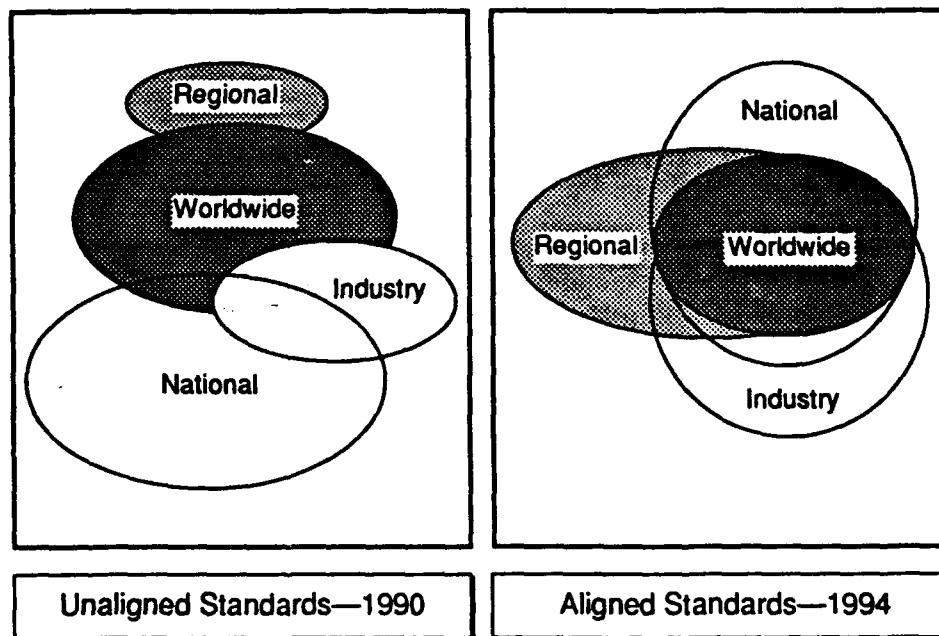


Fig. 5—A view of the move toward aligned standards

¹Others have offered the same or similar suggestions, including the Chair of ANSI ASC X12 (Hutcheson, undated), the ANSI ASC X12 Alignment Task Group; the CALS Information Technology Working Group and MAP/TOP Architecture Committee (CALS Information Technology Working Group and MAP/TOP Architecture Committee, 1990, p. 17); and JTC1 SWG-EDI (Kane et al., 1990).

standards, today not a significant factor in the standards world, may become more important as regional trade groups develop their own standards.

Aligned standards could take several forms. Three forms offer reasonable flexibility to EDI users and continuity for current users of non-EDIFACT message standards:

Tailored EDIFACT messages would be subsets of approved EDIFACT standards tailored for particular uses. In this case, the EDIFACT standards would serve as frameworks on which to build more tailored messages. Individual users and entire industry groups already do this now. These would actually not be separate standards but tailored implementations of EDIFACT standards.²

EDIFACT-Like messages would follow the current EDIFACT syntax, directories, and message conventions, but for purposes not yet addressed by finalized EDIFACT messages. These messages might be developed by a regional or industry group, even X12, and should be introduced into the EDIFACT process to ensure and maintain alignment.

Non-EDIFACT messages would be those developed prior to a certain date in a public non-EDIFACT, standard-setting process and not consistent with EDIFACT syntax. Users of these messages should be encouraged to transition to EDIFACT messages when available or EDIFACT-like messages, and "crosswalks" from these standards to EDIFACT standards should be developed.

Accomplishing Alignment

The alignment process should not be viewed as a nationalistic process with comparable changes required on both "sides"—DoD and others working for alignment should not "keep score." Rather, DoD should support alignment actions already under way to enhance the usefulness of the common standard features. ANSI X12's current efforts to

²An example of something similar to this already occurring within EDIFACT is the draft payment order message for banks. Because of different banking practices in Europe and the United States, EDIFACT has now drafted a second, more extended payment order message to accommodate these differences. A better approach might have been to include fields within *one* message—not two—to meet both sets of business practices. Users could then tailor their use of the message to meet their business needs and, if business practices moved closer together, the message standards themselves would not have to change, but simply the way the one message standard were used.

absorb various industry standards are in the right direction and will speed up this process. X12 cannot, of course, accomplish this unilaterally: Alignment must take place within the EDIFACT standards process. More changes are likely to be needed to non-EDIFACT standards, including X12, to make them all compatible with EDIFACT. DoD should encourage, where possible, cooperative alignment efforts among non-EDIFACT standards *and* EDIFACT.

To the extent DoD can influence the alignment process, it should ensure that lessons learned from ANSI X12's (and U.S. industry's) many years of message development are considered, but an "improvement" to EDIFACT should not be proposed solely on the basis that X12 follows it, for that will be an unacceptable answer for other non-X12 users in the standards process. Other standards may also offer lessons and improvements, e.g., those in commercial aviation with long experience with interactive EDI. Inevitably, choices will be necessary when either of two approaches would be satisfactory. The objective is to agree on one approach whenever possible.

DoD should monitor the efforts of JTC1 SWG-EDI at developing a conceptual model for truly open (i.e., interoperable) EDI for they may offer improvements to *all* EDI standards.

Any changes to X12 to accomplish alignment will affect DoD and its vendors to the extent they now use X12.³ The move to aligned standards will be by no means painless for these users. Of course, even finalized X12 messages are never stable, and their users must adjust as changes are made (supported by a system of version controls). As long as syntax and basic rules do not change, though, many of these changes can be made in tables in translation software. But changes needed for alignment may affect X12 syntax in ways that require more costly adjustments for current users. Therefore, the process should be gradual but steady and well documented, with changes announced in advance. Older versions of messages should be supported for a reasonable, but finite, period of time.

This major task of alignment cannot be accomplished by the small ASC X12 alignment committee alone. To the extent resources allow, DoD should play an active and direct role in the committee and in both the EDIFACT and X12 standards processes to increase the likelihood that this convergence of processes and standards

³Recall that fewer than 400 organizations are active members of X12, and that a 1989 survey found that roughly a third of U.S. firms using EDI used proprietary standards, and the remainder used either X12, industry standards, or EDIFACT. (Transportation Data Coordinating Committee, 1989, p. 15.)

progresses steadily. Some see the committee's current plan to align by 1994 as too ambitious, but it may be far too slow. We address timing of alignment milestones later in this section.

Finally, to the extent resources allow, DoD should assist the committee and ASC X12 leadership in keeping the ASC X12 membership well informed of the alignment process: why it is occurring, the ASC X12 endorsements of it (and more may be needed), and how it is progressing. Differing national perceptions of this process and its outcome should not be allowed to develop as they did in the mid-1980s.

Maintaining Alignment

As difficult as the alignment will be, the *maintenance* of the aligned standards in compatible standards processes is a more difficult challenge. Having one global standard implies having one standards process to maintain and improve it. However, as in the "one standard" case, the reality will be a series of compatible standards processes that are closely linked. Because of the commitments of many countries, the international process for EDI message standards should be the UN/ECE WP.4 EDIFACT process or any process that evolves from it. As these standards stabilize, they may be recommended to be ISO standards, but this is not required if the criteria for a reasonable international standards process are met.

DoD should work with other participants in EDIFACT to improve the process. Version control of messages is a critical aid for users. The current work on an electronic database of proposed, draft, and finalized messages should be completed. This is a critical tool to keep the growing number of working groups coordinated and working with a common set of message building blocks. Other means may be needed to keep working groups across the globe in coordination and communicating. These groups may develop different draft messages even for the same function, but they should do this with knowledge of what other groups are doing.

The process will need other improvements as it matures, but we cannot specify all that might be needed. Simply, the process should be structured to

- Allow participation by all interested EDI users, individual firms and industry groups
- Follow reasonable protocols for considering users' input

- Offer stability with a controlled but reasonably efficient process for change
- Provide accurate documentation of the common building blocks (syntax, data elements, codes, segments, conventions) of messages.

What should the role of ASC X12 be in this standards future? It could take several forms. During the alignment process, ASC X12 will already have adopted the international syntax and will have synchronized its data elements and coding with EDIFACT. We recommend that DoD work within ASC X12 to help it evolve in several ways:

- *To integrate EDIFACT message development even more fully into its own message development process.* Any message developed should be compatible with the international building blocks. It should then be introduced into the EDIFACT process as a proposal to follow the EDIFACT process to finalization.
- *To modify its process and voting schedule to be compatible with the EDIFACT schedule.* Such changes have already been proposed by the alignment committee.
- *To control and document any proposed EDIFACT messages that its committees develop, keeping them in coordination with EDIFACT syntax and directory changes, if any.* Any such proposals should be moved through the EDIFACT process as quickly as possible. They should be controlled as ASC X12 messages only for a transition period.
- *To view EDI message standards as frameworks from which different users, industries, or even countries choose data elements to use.* ASC X12 working committees could lead the development of these implementation guides, helping to keep them as similar as possible.
- *To the extent possible, not to develop or propose "U.S." EDIFACT messages.* If there are unique U.S. requirements for messages, they should be introduced as versions or modifications to EDIFACT messages. This occurred recently with a draft EDIFACT remittance advice message where banking conventions in the U.S. and Europe called for different data in such a message. The proposed resolution was a different version of the message. A better solution might have been simply an additional optional field.

- *Through its committees, to identify improvements to proposed or finalized EDIFACT messages based on experience with widely used X12 messages.* The EDIFACT working committees for both the NAEB and WEEB are already open to such suggestions, but there may be many more to be made. No one seriously interested in the success of standards wants lessons gained from years of message use to be lost.⁴

Although not mandatory to meet DoD's objectives for standards, ASC X12's role might eventually evolve even further to eliminate the importance of member votes on proposed messages or changes to messages. If it did so, its committees would serve essentially as working committees supporting the NAEB, as WEEB is supported by working committees. There are pros and cons to such a change, and it goes beyond the scope of this report to spell them all out or recommend a direction. In any event, those in the United States that develop and use messages should participate directly in meetings with the working groups of all the EDIFACT boards, called joint rapporteur meetings. As ASC X12 gradually changes its role, more of its members may choose to attend such meetings.

One way of envisioning ASC X12's future role would be as equivalent to various industry associations working on standards. For example, CCC, CEFIC, the International Air Transport Association, and the Automotive Industry Action Group are important sources of message development for the EDIFACT standards development process. Similarly, the Automotive Industry Action Group and other industry groups play important roles in the X12 process. They do not (or not any longer) develop standards independent of the international process, but they also do not passively subordinate themselves to EDIFACT; they play strong roles in committees so that EDIFACT "works for them."

⁴The EDIFACT transportation messages are an example of EDIFACT message development that has been built upon the transportation industry's long experience with EDI—and their use of TDCC (now becoming X12) messages. When TDCC standards were developed, they were developed by mode, e.g., for ocean, motor, or rail transport. The different sets of messages were inconsistent in their data elements, inhibiting their extension into cross-modal, point-to-point transportation services. Those developing the EDIFACT transportation messages learned from this experience. They first developed a message framework from which many messages could be developed tailored by mode as necessary. Each message draws from a common set of data elements.

Resources to Accomplish and Maintain Alignment

The ANSI X12 and international EDIFACT processes (and the many other standards processes) all have some resources to accomplish their missions, but they rely primarily on work by volunteers from interested businesses. ANSI X12 members do pay dues for administrative support, and NAEB members pay similarly for a modest amount of administrative support. (The WEEB is supported more generously through the EEC with additional payments from EFTA countries.)

Alignment of EDI message standards worldwide and the processes that develop and maintain them will take time and resources beyond what is needed simply to develop standards. The sooner these efforts are accomplished the better; the longer standards develop on different courses, the more difficult it will be to align them and the higher the cost to the growing number of users. Therefore, we recommend that DoD work with the ANSI X12 membership and the NAEB to address how to provide additional support where members identify needs and still meet the tight time line suggested below.

ISSUES FOR DoD TO HELP ADDRESS

In Sec. 5, several issues were described that need to be addressed by any EDI standards process. DoD should work with others in the ASC X12 and EDIFACT processes to address each of them to meet its business requirements. It should encourage international involvement in their solutions to gain the most from users' experience worldwide. To achieve its aggressive goals for electronic commerce, DoD must address improving the usefulness and actual use of nonmessage standards needed for EDI: X.400 and X.500. Addressing the interactive EDI requirements may also be useful to DoD in the short run to make the use of its proposed procurement bulletin boards successful. Changes to the OSI Reference Model should be considered only within the ISO community and as clear needs are identified.

Incorporating business and information modeling techniques better into the standards development and implementation process will help DoD reap more benefits from EDI.

Legal issues and the evolution of EDI beyond trade are two areas where DoD and U.S. industry have already done much work that could be shared to mutual benefit with EDI users globally. DoD should consider ways to open at least parts of the important CALS

work to the international community, again to mutual benefit. Others may be willing to develop jointly or to help evaluate CALS and EDI prototypes or tests. This may mean that parts of the CALS process should eventually move outside of DoD into a more public and even international forum. DoD's interests in EDI and CALS do not include serving as a de facto standards development and maintenance organization.

DoD should also share its prototypes of its IGP as interest is expressed in it, given the concerns of so many other EDI users about making EDI accessible and beneficial to small businesses. Again, there may be interest in joint development projects in this area, saving DoD resources and multiplying the experience gained during development.

The importance of quality assurance and version control has already been mentioned above.

Recommended Time Line

To achieve the above recommendations, DoD should help accomplish the critical milestones listed in Table 1. The table presents milestones from the U.S. perspective and is generally consistent with the draft timetable of the ASC X12 alignment task group.⁵

The process will necessarily be evolutionary. The dates are somewhat arbitrary, but should be used as indicators of relative urgency and, to some extent, logical order. For example, alignment should occur as soon as possible. Changes to standards processes themselves will logically occur after alignment, as participants gain confidence in the aligned standards.

Syntax can and should be aligned by 1993, with agreement in principle before then, if possible. The directories will be much more difficult, but they should be fit within a common structure by 1993, with inconsistencies and overlaps identified. Complete alignment will take longer, perhaps until 1994. Once these critical milestones are achieved, messages themselves will begin to merge, for there will be no more need for ANSI X12 and EDIFACT messages to handle the same business function. But the elimination of messages should fall

⁵Warner, 1990. The task group does not have a formally published set of milestones.

Table 1

**RECOMMENDED U.S. MILESTONES TO ALIGN ANSI X12/EDIFACT
EDI MESSAGE STANDARDS AND MAINTAIN ALIGNMENT**

Event	Recommended Target Date
Standards:	
Alignment of syntax	1993
Alignment of directories (data elements, segments, coding) with inconsistencies identified	1993
Migration guidelines for X12 users	1993
Alignment of conventions for use, implementation guides	1993
Elimination of inconsistencies in aligned directories	1994
Standards processes:	
Broad X12 agreement on steps needed to align X12 with EDIFACT and any desired changes to EDIFACT process	1991
Implementation of all necessary steps to X12 process to maintain alignment with EDIFACT	1992

out of the syntax and directory alignments and should be driven by business needs.

As alignment progresses, ANSI X12 will need to develop migration guidelines to ease the transition for standard users.

There are only two milestones listed in Table 1 for changing the standards process, because as long as the process meets the criteria suggested earlier, it may take several directions. It is important to get broader support and explicit recognition from ASC X12 membership of the alignment effort in the near term. Once this is done, the steps should be carried out fairly quickly—by 1992 if possible.

Indicators to Monitor

DoD will be an important player in changing EDI standards, but only one of many players. It cannot directly control how standards and standards processes will evolve. However, as this report describes, it is in DoD's best interests to help move the EDI community to a set of standards that are operable worldwide, to open EDI. We recommend that DoD ensure that a brief, objective, annual review of progress

toward this goal be conducted. The review should assess progress on the following points:

- Milestones in Table 1 have been achieved or still appear achievable.
- ANSI X12 membership at the least and, ideally, the U.S. EDI user base continue to support the movement toward a worldwide set of interoperable EDI standards.
- The EDIFACT process within North America and internationally is considering in good faith and acting upon U.S. recommendations to achieve open EDI.
- The X12 and EDIFACT processes are progressing steadily in the development of standards to meet users' needs and address common concerns including legal issues and the following:
 - The use of and improvement to the X.400 CCITT message handling standards for EDI, specifically X.435
 - The use of X.500 directories to facilitate open EDI and the integration of such directories into telecommunication networks supporting EDI
 - Addressing worldwide EDI business needs beyond trade, including product design, manufacturing, distribution, and after-sale
 - As business needs demand, the development of standards to facilitate interactive EDI
 - The development of systems or networks to certify translation software between EDI standards and implement version control of EDI message standards.

If an annual review indicates that this progress is not being made, DoD should reevaluate its position on standards and its role in the standards-setting process to achieve its objectives. It may have to redouble its efforts to help accomplish the above milestones or change them.

Appendix A

A PRIMER ON EDI MESSAGE STANDARDS

EDI message standards have several parts with different names, depending on the standard used:

	EDIFACT	ANSI X12
A discrete business transaction made up of a set of information for a business function, e.g., invoice.	Message	Transaction Set
A set of rules defining the "grammar" and structure of a message.	Syntax	Syntax
Pieces of information that are grouped together in a message because they are related to a single object or entity, e.g., name and address.	Segments	Segments
The smallest individual unit of information in a message, e.g., name, zip code, manufacturer. Some are mandatory, some optional. Some are conditional (optional), i.e., only required under certain conditions. The EDIFACT composite data element is a data element coupled with other conditional data elements.	Data elements Mandatory Conditional Composite	Data elements Mandatory Conditional Optional
Codes are used to efficiently identify products, colors, services, locations, etc. Qualifiers are special codes that more specifically define a more generic data element.	Codes and Qualifiers	Codes

EDI standards include message design guidelines with the conventions for message construction. They also use directories of data elements and codes, ideally, consistently across messages or transaction sets. Finally, implementation guidelines for specific industries using

the standards describe the uses of messages, data elements, and codes within an industry.

For more detailed descriptions of ANSI X12 and EDIFACT standards, see North American EDIFACT Board, 1989, and ANSI, 1987.

Appendix B

STATUS OF EDIFACT MESSAGES

The following are the 41 technically assessed messages as of October 1990:

Tag	Message Name	Status*		
		0	1	2
CONTRL	Control Message		9/89	
CREADV	Credit Advice Message	3/90	9/90	9/91
CREEXT	Extended Credit Advice	3/90	9/90	9/91
CURRAC	Current Account Message	6/89	3/91	
CUSCAR	Customs Cargo Message	9/90	3/91	
CUSDEC	Customs Declaration Message	6/89	9/89	9/91
			9/90	
CUSREP	Customs Report Message	9/90	3/91	
CUSRES	Customs Response Message	6/89	9/89	9/91
			9/90	
DEBADV	Debit Advice Message	3/90	9/90	9/91
DELFOR	Delivery Schedule Message	6/89	3/91	
		3/90		
DELJIT	Just In Time Delivery Message	6/89	3/91	
		9/90		
DESADV	Despatch Advice	9/90	3/91	
DIRMNT	Directory Maintenance Message	3/91		
DIRSET	Directory Set Message	3/91		
GENRAL	General Purpose Message	3/88	3/91	
IFCSUM	Forwarding and Consolidation Summary Message	9/90	3/91	
IFTMBC	Booking Confirmation	3/90	9/90	9/91
IFTMBF	Firm Booking	3/90	9/90	9/91
IFTMBP	Provisional Booking	3/90	9/90	9/91
IFTMFR	International Forwarding and Transport Message Framework	3/89	9/89	9/91
			9/90	
IFTMAN	Arrival Notice	3/90	9/90	9/91
IFTMCS	Instruction Contract Status	3/90	9/90	9/91
IFTMIN	Shipping Instruction	3/90	9/90	9/91

Tag	Message Name	Status*		
		0	1	2
INVOIC	UNSM Invoice			9/88
INVRPT	Inventory Report	3/91		
LOCAPP	Application for a Letter of Credit	3/91		
ORDCHG	Purchase Order Change	6/89	3/91	
ORDERS	UNSM Purchase Order		3/89	3/90
ORDRSP	Purchase Order Response	6/89	3/91	
PARTIN	Party Information Message	6/89	3/91	
PAYEXT	Extended Payment Order		9/90	9/91
PAYMUL	Multiple Payment Order	9/90	3/92	
PAYORD	Payment Order Message	3/90	9/90	9/91
PRICAT	Price/Sales Catalogue Message	6/89	3/91	
QUALITY	Quality Data Message	3/89	9/89	9/91
QUOTES	Quotes	6/89	3/91	
REINAC	Reinsurance Account Message	6/89	9/91	
REMADV	Remittance Advice	6/89	9/90	9/91
REQOTE	Request for Quote	6/89	3/91	
STATAC	Statement of Account	6/89	3/91	
DOCAPP	Documentary Credit Application	3/90	3/91	

SOURCE: Western European EDIFACT Board message tracking system, CEBIS, Commission EDIFACT Board Information System.

*Estimate of when status will be achieved. Many factors can speed up or slow down a message's progress. Status 0 means a draft document issued for information only; Status 1 means message for formal trial use; Status 2 means a message that has been formally recommended and registered by WP.4.

Appendix C

A CROSS REFERENCE TO EDIFACT AND ANSI X12 STANDARDS

X12	Transaction Description	EDIFACT	EDIFACT
			Status
810	Invoice	INVOICE	2
819	Operating Expense Statement		
820	Payment Order/Remittance Advice	REMADV	1
822	Customer Account Analysis		
823	Lockbox		
830	Planning Schedule/Release Capability	DELFOR	0
832	Price Sales Catalog	PRICAT	0
840	Request for Quotation (RFQ)	REQOTE	0
843	Response to Request for Quotation	QUOTES	0
844	Product Transfer Account Adjustment (A.A.)		
845	Price Authorization Ack/Status		
846	Inventory Inquiry/Advice		
849	Response to Product Transfer A.A.		
850	Purchase Order (P.O.)	ORDERS	2
855	P.O. Acknowledgment	ORDRSP	1
856	Ship Notice/Manifest	DESADV	0
858	Shipment Information	IFTMIN	1
860	P.O. Change	ORDCHG	1
861	Receiving Advice		
862	Shipping Schedule	DELJIT	0
863	Report of Test Results	QALITY	1
865	P.O. Change Acknowledgment		
867	Product Transfer and Resale Report		
869	Order Status Inquiry		
870	Order Status Report		
997	Functional Acknowledgment	CONTRL	1

NOTE: The X12 transaction sets listed are only those officially released as standards or for trial use. Many other transaction sets are in various stages of development.

Appendix D

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Appendix E

COUNTRIES AND ORGANIZATIONS PARTICIPATING IN UN/ECE WP.4 ACTIVITIES

United Nations Member States Participating in UN/ECE:

Australia	Netherlands
Austria	New Zealand
Belgium	Nigeria
Bulgaria	Norway
Canada	Poland
Czechoslovakia	Portugal
Denmark	Romania
Finland	Senegal
France	Singapore
Federal Republic of Germany	South Africa
Greece	Spain
Hungary	Sri Lanka
Iceland	Sweden
Ireland	Switzerland
Israel	Turkey
Italy	Union of Soviet Socialist
Japan	Republics
Kenya	United Kingdom
Republic of Korea	United States
Malta	Yugoslavia

Organizations:

Intergovernmental:

- Customs Cooperation Council**
- Commission of the European Communities**
- European Free Trade Association**

UN Specialized Agencies:

- General Agreement on Tariffs and Trade**
- International Civil Aviation Organization**
- International Maritime Organization**

International Telecommunications Union
UN Industrial Development Organization

UN Departments and Organs:

UN Commission on International Trade Law
UN Conference on Trade and Development

Nongovernmental Organizations:

International Railways Transport Committee
International Article Numbering Association
International Federation of Freight Forwarders Association
International Association of Ports and Harbors
International Air Transport Association
International Chamber of Commerce
International Chamber of Shipping
International Data Exchange Association
International Road Transport Union
International Organization for Standardization
Society for Worldwide Interbank Financial Telecommunications
International Union of Railways
Union of International Rail/Road Transport

SOURCE: UN/EDIFACT Rapporteurs' Teams, *Introduction to UN/EDIFACT*, April 1990 with updates in December 1990 by UN/ECE WP.4 secretariat.

GLOSSARY

AIAG	Automotive Industry Action Group
ANSI	American National Standards Institute: a nongovernmental, nonprofit, private organization. Its members are businesses, government agencies, vendors, and other interested parties
ASC X12	ANSI Accredited Standards Committee charged with development of EDI transaction sets
ASYCUDA	Automated System for Customs Data
AUSTRIAPRO	Austrian trade facilitation organization
CALS	Computer-Aided Acquisition and Logistic Support: a DoD initiative, in cooperation with private industry, to develop standards for electronic exchange of documents from defense contractors, such as engineering drawings, specifications
CCC	Customs Cooperation Council
CCITT	Consultative Committee for International Telegraph and Telephone: the organization that establishes recommendations for international communications standards
CEC	Commission for the European Communities
CEFIC	Conseil Européen des Fédérations de L'Industrie Chimique (European Chemical Industry Federation)
CEN	European Committee for Standardization
DISA	Data Interchange Standards Association: the nonprofit secretariat for ASC X12 and the NAEB
DoD	Department of Defense
EDI	Electronic Data Interchange
EDIFACT	EDI for Administration, Commerce and Transport
EDIFICE	Electronic Data Interchange Forum for Companies with interests in Computing and Electronics
EDIFRANCE	French organization supporting use of EDIFACT
EEC	European Economic Community: 12 nations

EFTA	European Free Trade Association: 6 European nations outside of the EEC
FAR	Federal Acquisition Regulation
FIPS	Federal Information Processing Standard
FMS	Foreign Military Sales
GE.1	Group of Experts, Data Elements and Automated Data Interchange, Working Party 4, UN/ECE
GE.2	Group of Experts, Procedures and Documentation, Working Party 4, UN/ECE
GOSIP	Government Open System Interconnection Profile: the U.S. government's adoption of OSI
IDEA	International Data Exchange Association
IEC	International Electrotechnic Commission
IGP	Intelligent Gateway Processor, being developed for DoD at Lawrence Livermore National Laboratory as a critical part of DoD's electronic infrastructure for electronic commerce
ISO	International Standards Organization: a voluntary, nontreaty organization with members being national standards organizations from 89 countries. The U.S. representative to ISO is ANSI.
JTC1	Joint Technical Committee No. 1, Information Technology, of the ISO/IEC
MODELS	MOdernization of DEfense Logistics Standard Systems
NAEB	North American EDIFACT Board
NIST	National Institute of Standards and Technology
ODETTE	Organization for Data Exchange Through Telecommunications in Europe: ODETTE has an EDI standard used by the European automotive industry
OSD	Office of the Secretary of Defense
OSI	Open System Interconnection Reference Model for computer interconnections over electronic networks
RINET	Reinsurance and Insurance Network: an international network set up by eight European reinsurance companies

SITPRO	Simpler Trade Procedures Board, a UK trade facilitation organization
SWG-EDI	Special Working Group on EDI of ISO JTC1
SWIFT	Society for Worldwide Interbank Financial Telecommunication
TDCC	Transportation Data Coordinating Committee, now EDIA
TEDIS	Trade Electronic Data Interchange Systems: a program of the CEC
TRADACOMS	Trade Data Communications: an EDI standard developed and used in the UK
UCC	Uniform Code Council, Inc.
UCS	Uniform Communications Standard: EDI standard used by the grocery industry developed by the UCC
UK	United Kingdom
UNCTAD	United Nations Conference on Trade and Development
UN/ECE	United Nations Economic Commission for Europe
UN/JEDI	United Nations Joint EDI: an ad hoc group of WP.4 formed in 1986
UNSM	United Nations Standard Message, an EDIFACT term
UNTDDED	United Nations Trade Data Elements Directory
X12	ANSI standard transaction formats for EDI
X.400	CCITT standard for electronic mail interchange
X.500	CCITT standard for electronic directory of electronic mail addresses
WEEB	Western European EDIFACT Board
WP.4	UN/ECE Working Party on Facilitation of International Trade Procedures

BIBLIOGRAPHY

- American National Standards Institute (ANSI), *An Introduction to Electronic Data Interchange*, ANSI Accredited Standards Committee X12, Document ASC X12D/87-02, Data Interchange Standards Association (DISA), Washington Publishing Company, Gaithersburg, MD, July 1987.
- , *X12-ISO 9735 Syntax Comparison and Recommendations*, ASC X12C/89-211, ANSI Accredited Standards Committee X12, Data Interchange Standards Association, Alexandria, VA, April 7, 1989.
- Bureau of Economic Analysis, U.S. Department of Commerce, *Survey of Current Business*, Vol. 66, No. 3, Superintendent of Documents, U.S. Government Printing Office, March 1986.
- Bureau of Economic Analysis, U.S. Department of Commerce, *Survey of Current Business*, Vol. 68, No. 3, Superintendent of Documents, U.S. Government Printing Office, March 1988.
- Bureau of Economic Analysis, U.S. Department of Commerce, *Survey of Current Business*, Vol. 69, No. 3, Superintendent of Documents, U.S. Government Printing Office, March 1989.
- Bureau of Economic Analysis, U.S. Department of Commerce, *Survey of Current Business*, Vol. 70, No. 3, Superintendent of Documents, U.S. Government Printing Office, March 1990.
- CALS Information Technology Working Group and MAP/TOP Architecture Committee, "Final Draft, EDI's Role in a Strategy for Digital Data Exchange," CALS Policy Office, Department of Defense, March 12, 1990.
- CHAMBERNET Europe, "Multilingual Product Description (MPD), A European Project," internal document received from AUSTRIAPRO, Vienna, Austria, (undated).
- Conseil Européen des Fédérations de L'Industrie Chimique (CEFIC), *Trade Reference Information Model, A Global Model*, A Working Document, Brussels, Belgium, 1990.
- Commission of the European Communities, *TEDIS Programme 1988-1989 Activity Report*, COM(90) 361 Final, Brussels, 25 July 1990.

CCITT, *Message Handling Systems: EDI Messaging System, Draft Recommendation X.435*, EX-334, Version 5.0, Lausanne, Switzerland, June 15, 1990a.

CCITT, *Message Handling: EDI Messaging Service, Draft Recommendation E.435*, EX-335, Version 5.0, Lausanne, Switzerland, June 15, 1990b.

Department of Defense, *Defense Management Report Decision No. 941*, U.S. Government, Washington, D.C., November 12, 1990.

Department of Trade and Industry, *EDI Standards: A Guide for Existing and Prospective Users*, A Vanguard Report, Her Majesty's Stationery Office, London, UK, 1989.

Directorate-General XIII Telecommunications, Information Industries and Innovation, *EDI in Perspective*, EUR 11883 EN, Catalogue CD-NA-11883-EN-C, ECSC-EEC-EAEC, Brussels-Luxembourg, 1989.

EDI News, "Around the World with EDI: An Update," Vol. 4, No. 4, March 29, 1990, pp. 3-4.

EDI News, "Debate Continues Over EDIFACT in EDI Community," Vol. 4, No. 2, January 29, 1990.

EDI News, "EDI Activity is Projected to Escalate Down Under," Vol. 4, No. 4, March 29, 1990, p. 3.

EDI News, "EDI in Canada: Trading with the Great White North," Vol. 4, No. 6, March 26, 1990, pp. 1-3.

EDI News, "EDI in New Zealand," Vol. 4, No. 6, March 26, 1990, pp. 3-5.

EDI News, "Japan is Setting its Sights on International EDI: Migrating Appropriate Industries Away from Domestic Formats," Vol. 4, No. 12, January 29, 1990, pp. 1-3.

EDI News, "SWIFT to Implement UN/EDIFACT Standards," Vol. 4, No. 10, May 22, 1990, p. 5.

EDI News, "U.S. Customs to Utilize EDIFACT Messages in Operational Tests," Vol. 4, No. 2, January 29, 1990, pp. 7-8.

Electronic Data Interchange Association (EDIA), in cooperation with the Gartner Group, Inc., *EDI in North America: Status of Use and Technology*, EDIA, Alexandria, VA, 1989.

Fawcett, Robert, AT&T/ISTEL, "EDI in Europe," address to the Second International Congress of EDI Users, San Francisco, July 17, 1990.

Ferguson, Daniel M., and Ned C. Hill, "The State of EDI in Canada: 1988," *EDI Forum*, 1989, pp. 161-164.

Ferguson, Daniel M., and Ned C. Hill, "The State of U.S. EDI in 1988," *EDI Forum*, 1989, pp. 21-29.

GE.1, *PEDI—Presentation*, Item 5, CRP N. 7, R. 699, UN/ECE WP.4, Geneva, Switzerland, September 18, 1990.

Hampel, Viktor E., "Protection of Logistics Unclassified/Sensitive Data and Systems in the OSD 'PLUS' Program, an Update," presented to the CALS Industry Steering Group Meeting, CALS Technology Working Group, National Institute of Standards & Technology, May 1-3, 1990.

Hutcheson, Kenneth R., Chair, ANSI ASC X12 Committee, "An Open Letter to the Global EDI Community," ASC X12S/89-687, E. I. Du Pont de Nemours & Co., Wilmington, DE, undated (1989?).

INPUT, EDIFACT: A Status Report and Guide to Decision Making, TDCC: The Electronic Data Interchange Association, Alexandria, VA, December 1989.

INPUT EDI Reporter International, "British Telecom Buys McDonnell Douglas Information Services," Vol. 4, No. 9, September 1989, pp. 1-4.

INPUT EDI Reporter International, "Global EDI Issues Discussed in Vancouver," Vol. 4, No. 9, September 1989, p. 6.

International Monetary Fund, *Direction of Trade Statistics Yearbook*, Washington, D.C., 1990.

Iwasaki, Yuji, "EDI in Japan," *EDI Forum*, 1990, pp. 130-134.

Japan Information Processing Development Center, "EDI in Japan," *Japan Computer Quarterly*, No. 80, 1990.

Kane, J., P. Lestang and Georges Malamoud (editors), *First Draft Version of the Report on the Conceptual Model for EDI*, ISO/IEC JTC1/SWG-EDI N 150, 1990-8-2 (Version 1.5), International Standards Organization, SIS (Secretariat for SWG) Sweden, August 2, 1990.

- NIST, *Federal Information Processing Standard (FIPS) Publication 146, Government Open Systems Interconnection Profile (GOSIP)*, U.S. Government, August, 1988.
- NIST, "Federal Information Processing Standard (FIPS) Publication 161, Electronic Data Interchange (EDI)," *Federal Register*, Vol. 56, No. 61, March 29, 1991, pp. 13123-13126.
- North American EDIFACT Board, *ANSI X12 Transaction to EDIFACT Message, Recasting Tool Kit*, DISA No. X12IL-89-101, Data Interchange Standards Association (DISA), Alexandria, VA, May 1989.
- Notto, Ralph W., Jeff Sturrock, Colin M. Hill, Ray Walker, Earl J. "Buddy" Bass, Joseph G. Carley, Jr., "The EDI Standards Debate," *EDI Forum*, 1989, pp. 116-128.
- Payne, J. E., and R. H. Anderson, *Electronic Data Interchange (EDI): Using Electronic Commerce to Enhance Defense Logistics*, RAND, R-4030-P&L, 1991.
- Peeters, Emile, "The TEDIS Programme," *EDI-1992 and Beyond, Conference Proceedings*, Economic and Social Committee of the European Communities and International Data Exchange Association, Brussels, September 1989, pp. 23-32.
- Rapporteurs' Teams, UN/EDIFACT, *Introduction to UN/EDIFACT*, April 1990.
- Reich, Robert, "Who is Us?" *Harvard Business Review*, January-February 1990, pp. 53-64.
- Sarich, Alfredo, "An Update on EDI in 1989," *EDI-1992 and Beyond, Conference Proceedings*, Economic and Social Committee of the European Communities and International Data Exchange Association, Brussels, September 1989, pp. 17-21.
- Shepherd, Alan, "Implementing EDI in the European Automotive Industry," *EDI Forum*, 1989, pp. 171-172.
- Tanenbaum, A. S., *Computer Networks*, 2nd edition, Prentice Hall, New Jersey, 1988.
- Trade Facilitation News*, Trade/WP.4/TFN.72, TD/B/FAL/TFN.72, October 30, 1990.
- Trafford, Don, "Basics of EDIFACT Syntax Standards," speech delivered at the ANSI X12 EDI 1989 Conference, New Orleans, LA, April 12, 1989.

United Nations Economic Commission for Europe, "Report of the Thirty-Second Session of the Working Party on Facilitation of International Trade Procedures," Economic and Social Council, Trade/WP.4/173, October 4, 1990.

United Nations Economic Commission for Europe, "Report of the Forty-Second Session of the Meeting of Experts on Data Elements and Automated Interchange (GE.1)," Economic and Social Council, Trade/WP.4/GE.1/81, October 10, 1990.

United Nations Economic Commission for Europe, "Report of the Forty-Second Session of the Meeting of Experts on Procedures and Documentation (GE.2)," Economic and Social Council, Trade/WP.4/GE.2/81, October 10, 1990.

United Nations Economic Commission for Europe, United Nations Conference on Trade and Development, "Introduction to the United Nations Rules for Electronic Data Interchange for Administration, Commerce and Transport, (UN/EDIFACT), Note by the ECE Secretariat," *Trade Facilitation*, Trade/WP.4/INF.105, TD/B/FAL/INF.105, July 12, 1988.

van Maaren, Henk C., "The EDIFACT Standard," *EDI Forum*, 1989.

van Maaren, Henk, "EDI in International Trade and Transport: Economic Advantages," *EDI Forum*, 1989, pp. 169-170.

Warner, T. J., "Emigration: From One Standard to Another; From No Standard to EDIFACT," speech at the Second International Congress of EDI Users, sponsored by Electronic Data Interchange Association, San Francisco, CA, July 16, 1990.

Wigglesworth, Peter, "A Review of the Business Implications of EDI in the U.K.," *EDI Forum*, 1989, pp. 165-168.

Zinn, Deborah, "EDI in Australia," *EDI Forum*, 1989, ISSN 1048-3047.